FEBRUARY 10, 1957

electronics

business edition

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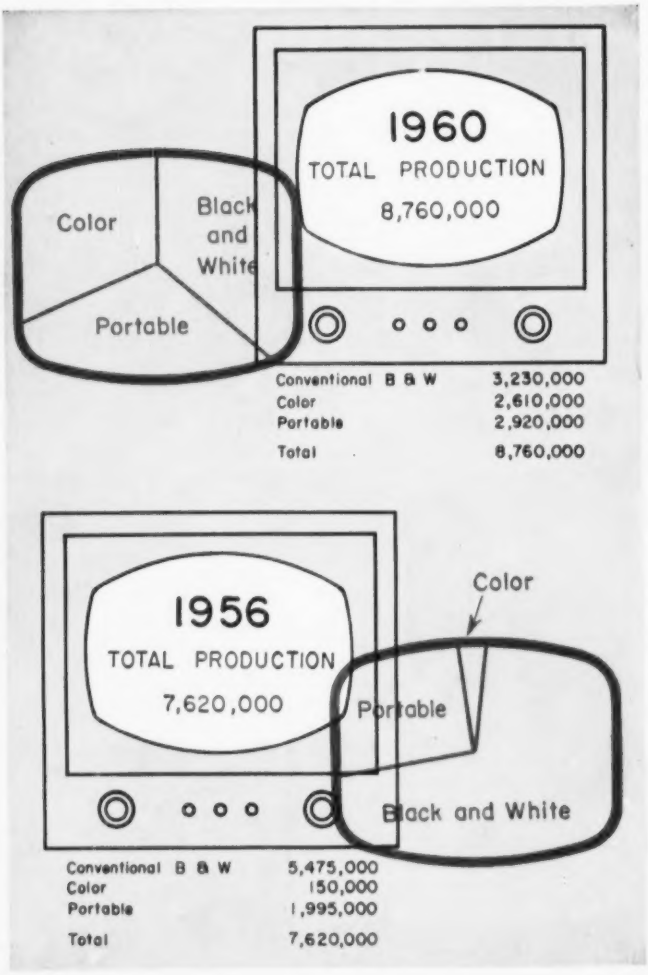

NEWS AT A GLANCE

2.5 MILLION TV SETS JAM WAREHOUSES AS . . . . Manufacturers decry price cutting (page 15) . . . Component users demand reliability, precision, uniformity (page 13) . . . More firms cash in on military repair (page 20) . . . Government plans to spend $3.3 million (page 22) . . . Analog computing units lead new products parade (page 32) . . .

Raytheon — World's Largest Manufacturer of Magnetrons and Klystrons

see Raytheon

for microwave and special tubes

Here are just six Raytheon Microwave and Special Tubes from the largest, most complete line in the industry. You can add many hours of reliable service to your microwave, radar and special equipment by designating Raytheon Tubes.

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Excellence RAYTHEON *in Electronics*

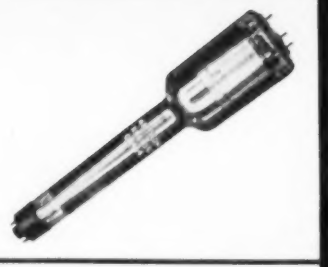
RAYTHEON MANUFACTURING COMPANY

Microwave and Power Tube Operations, Section PT-56

Waltham 54, Massachusetts

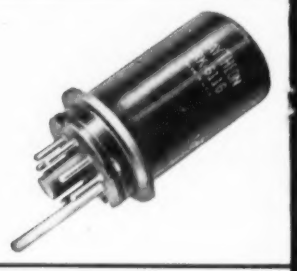
RK6835/QK464

Storage Tube
Magnetic Deflection Type
Resolution–400 lines



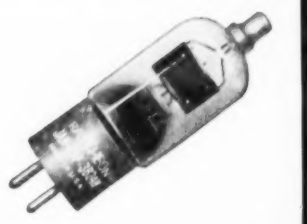
RK6116

Klystron
Ruggedized
Thermally Tuned
Frequency–
8500 to 9660 mc
Power Output–
35 mw



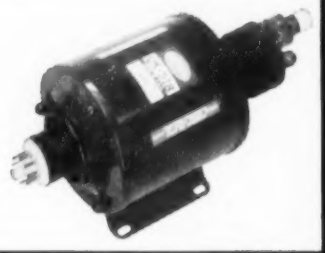
RK3B24W

Half Wave-High Vac.
Diode Rectifier
Max. Peak
Inverse Voltage–
20,000
Max. Peak
Current–300 ma



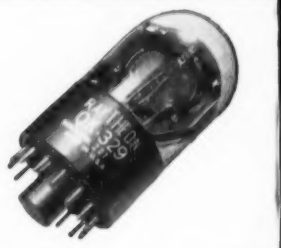
QK518

Backward-Wave
Oscillator
Frequency Range–
2000 to 4000 mc
Voltage Tunable
Power Output–
0.1 to 1.0 watts



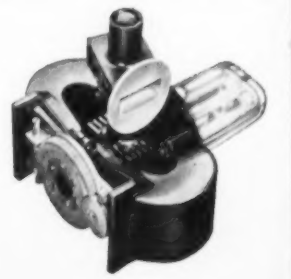
QK329

Square Law Tube
Function Multiplier



RK2J51A

Magnetron
Tunable–
8500 to 9600 mc
Peak Pulse Power–
40 kw min.



Regional Sales Offices: 9501 W. Grand Avenue, Franklin Park, Illinois
622 S. LaBrea Avenue, Los Angeles 36, California

Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Receiving Tubes, Picture Tubes, Transistors.

electronics
business edition

A McGraw-Hill Publication
Vol. 30, No. 2A

FEBRUARY 10, 1957

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Industry Outlook

AILING tv set manufacturing business is a matter of concern in many quarters. Monochrome sets brought in $912 million and color sets $54 million in 1956, but 2½ million sets produced last year are still in warehouses.

A turning point in the setmaking business could come about midyear, but it may be 1960 before a truly favorable profit situation returns.

- **First-set market saturation is still some time off; 78 percent of U. S. households have tv sets although 97 percent are within signal range. Potential market: some 11,740,000 sets.**
- **Years 1961-62 will see a substantial increase in first-set sales as a bumper crop of war-babies forms new households.**
- **Replacement market should grow. Many sets are already 4 years old or older.**
- **Second-set market is barely scratched—5.5 percent of households.**
- **National standard of living continues to rise. People like to "trade up"—cabinet styling, hi fi, big screens all count.**
- **Technical advances: Color is coming, may outsell monochrome by 1962. Battery-powered transistorized tv will be a hot item.**

The tv set manufacturing business is a good one. The cards are stacked in its favor. But a firm with a future needs the design, manufacturing and marketing skills that always separate industry's men from boys.

▼

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CAPACITORS

Announcing

A high quality line of paper capacitors.
General Electric's molded
PVZ *tubular*
capacitors.

A new line:

General Electric's molded PVZ* tubular capacitors operate from −55 C to +125 C

. . . yet are moderately priced

The new General Electric molded PVZ paper tubular capacitors meet the electronic designer's need for a high-quality line that offers, at a moderate price, characteristics similar to "K" of MIL-C-25A.

- Price of the units is less than one-half that of a comparable metal-clad tubular.
- They are designed for a minimum of one year's life, operating at 125 C, rated voltage.
- Insulated bodies are easy to locate in the chassis, and provide protection from other parts or ground.
- They are small, both physically and electrically, in order to aid equipment miniaturization.
- They are solid—resistant to shock and vibration.

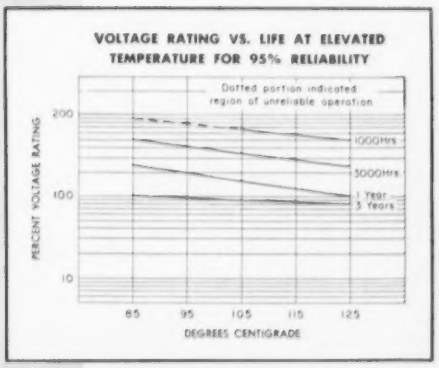
In general, you will find these molded PVZ paper tubular capacitors suitable for use where you might normally expect to find either 85 C or 125 C metal-clad tubular capacitors; in computers, missiles, telephone equipment, and other high-grade military and commercial electronic equipment.

Microfarad ratings extend ***down*** to .00047 uf—100 to 400 volts; ***up*** to .15 uf—100 volts, .1 uf—200 volts, .068 uf—300 volts, and .022 uf—400 volts. Capacitance ratings are available with ±20%, ±10%, ±5% tolerances.

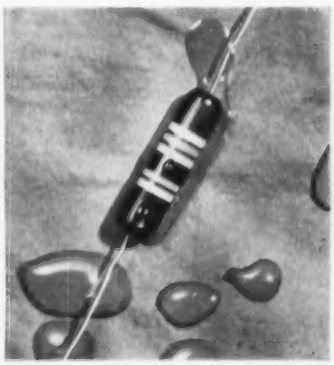
In many instances, the units are physically smaller than equivalent metal-clad tubulars, especially if the metal-clads are insulated. PVZ capacitors range in size from .175" diameter x $\frac{5}{8}$" long to .375" diameter x $1\frac{1}{16}$" long. Nine different sizes are offered to accommodate the various ratings.

READY NOW: Stocks of most sizes and ratings of General Electric's new PVZ capacitors are on hand, ready for shipment. If you would like to receive technical data on the new line get in touch with your local G-E Apparatus Sales Office or write to the General Electric Company, Section 442-43, Schenectady 5, N. Y.

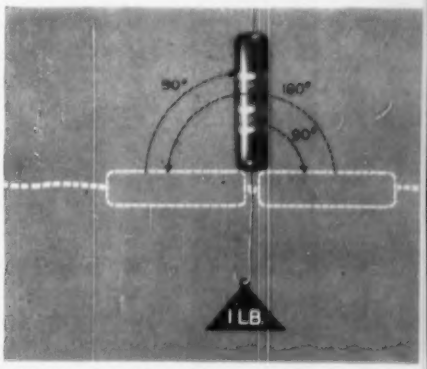
*A General Electric Trade-mark.



OPERATES FOR 1 YEAR AT 125 C Molded PVZ capacitors are designed for a minimum of one year's life at rated voltage and 125 C operation. Curves shown above are typical of performance.



EXCELLENT HUMIDITY CHARACTERISTICS Molded PVZ capacitors withstand stringent humidity tests, thanks to a combination of high-grade case material and carefully-controlled molding techniques.



HIGH LEAD BEND RESISTANCE The new capacitors withstand one-pound-vertical-pull test moving the body of the unit 90°, then 180° in the opposite direction, then back 90°, to the original vertical position.

Progress Is Our Most Important Product

GENERAL ELECTRIC

DU MONT SPACE-SAVER RADAR TUBES

Miniaturized in everything but screen size and performance, DuMont space-saver radar tubes meet modern air-borne radar requirements. *Available in 3 to 12-inch sizes.*

HIGH LIGHT OUTPUT AND RESOLUTION • LOW HEATER CURRENT • DESIGNED FOR FACE-PLATE MOUNTING • SMALL NECK WITH 9-PIN MINIATURE BASE • ELECTROSTATIC OR MAGNETIC FOCUS AND DEFLECTION.

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STREET favors our industry

Shares considered top for growth
Industry and defense favored
TV long-run prospects good

WALL STREETERS are impressed with the 1957 prospects for companies producing electronic equipment and components for defense, commercial and industrial applications.

The tv business is considered less promising. Most Street analysts expect radio-tv set manufacturers to maintain the same level of unit production as in 1956, but foresee narrower profit margins, lower selling prices and probably fewer manufacturers in the business. Standard and Poor's, however, expects lower unit production in 1957 to reduce heavy year-end inventories.

Bache forecasts mild improvement in operating conditions of television set manufacturers. Production levels will be maintained or increased by growing replacement sales, a spokesman said. Profit margins will firm because of the smaller number of competing firms, but net profit improvement will be small.

Analysts generally take an optimistic view of long-run prospects in the radio-tv set business. Television shares are worth holding onto because of favorable long-run prospects, points out a spokesman for Television-Electronics Fund. Wall Streeters foresee a future boom in color tv.

There is general agreement that companies filling Defense Department orders have excellent prospects.

What BROKERS say

BUYING and holding shares in growth companies is one road to capital-gains profits. Electronics is widely regarded as a promising growth industry. Many Wall Streeters are watching the business closely. Most of what they see, they like.

The research department of Merrill Lynch, Pierce, Fenner & Beane expects defense electronics business

SHARES and PRICES

SPECIAL INTEREST in electronics stocks is the common denominator of the mutual funds listed below. Net assets of open-end mutual funds with special interests in electronics stocks come to about $300,000,000, of which almost $200,000,000 is invested in electronics.

The desire to invest in industries that will benefit from new scientific developments has created the interest in electronics. The percentage of investment in electronics varies from funds like Axe Science and Electronics with about 20 percent to others like Television-Electronics with 100 percent.

As growth funds, the mutual funds listed here are principally interested in capital growth and secondarily interested in income return. A comparison of their dividend payments, which shows dividends from income overshadowed by dividends from capital gains, illustrates this fact. This type of dividend is taxable as a long-term capital gain.

There are indications that the number of electronics-oriented funds will increase as many have been organized in recent years. Electronics Investment was organized in 1955 while the Atomic Development, Axe Science & Electronics, Diversified Growth and Energy funds were all organized since 1952.

Mutual Funds	1956 Price Range [1]	Recent Price	1956 Dividends			Net Asset Value
			Total	Income	Capital Gains	
Atomic Development	13.71 – 15.37	15.53	0.70	0.44	0.26	$40,287,904 (Sept. 30)
Axe Science & Electronics	9.53 [2] – 10.14 [2]	9.80	0.10	0.10	none	15,305,143 (June 30)
Diversified Growth	10.89 – 14.03	13.26	0.79	0.18	0.61	14,848,423 (Sept. 30)
Electronics Investment	4.44 – 5.00	4.83	0.19	0.14	0.05	10,927,950 (July 31)
Energy	131.63 – 163.83	153.50	6.70	1.98	4.72	2,579,156 (Sept. 30)
Group Securities—Electronic	6.65 – 8.25	7.00	0.57	0.22	0.35	2,854,069 (Sept. 30)
National Securities—Growth	5.64 – 6.85	6.53	0.33	0.13	0.20	24,866,592 (Oct. 31)
Television-Electronics	10.79 – 12.61	11.68	0.92	0.36	0.56	132,618,446 (Oct. 31)
United Science	9.82 – 11.87	10.95	0.66	0.28	0.38	34,417,535 (Sept. 30)

[1] Bid, [2] Since July 27, 1956

will continue to improve because total defense expenditures will increase and a larger share will be devoted to missile guidance systems and other electronic equipment. This opinion is widely held.

A Bache researcher adds that many military electronic manufacturers who have been working on missile and other research projects are now ready for volume production, where profits will be larger.

The prospects for manufacturers of industrial and commercial equipment are considered good. The Value Line survey states that electrical and electronic controls for automatic factories are eagerly sought and that industrial controls have had a tremendous year.

The research director for Group Securities points out that the continued trend toward factory automation along with the continued high level of new plant construction will sustain a high level of demand.

Recently announced portfolio changes by Television-Electronics Fund reveal increasing emphasis on aircraft electronics, computers, instrumentation and controls.

Sees higher '58 PROFIT

"We are on solid ground today and expect to achieve a new post-war plateau of profit in 1958," Westinghouse president, Gwilym A. Price, told the financial press late last month. "Every level of management has its tail up," Price said.

The firm earned an estimated $15.5 million, or 82 cents per share, before inventory valuation adjustments, on sales of $1.5 billion in 1956. But, the adoption in October of the last-in, first-out (LIFO) method of inventory valuation lowered gross profits by $12 million and reduced net profits to $3.5 million or 10 cents per share.

The company's 1957 budget calls for sales of $2 billion and earnings of $4 per share. A growing backlog of unfilled orders supports the sales forecast, Westinghouse officials assert. In comparison with two years ago, unfilled orders are up: 86 percent for apparatus products, 55 percent for general products and 213 percent for atomic products. Other defense products are down 24 percent.

The company has big hopes for the long-term future of its atomic-power division. This division is still in the red.

But it is playing for big stakes, a position of leadership when the Navy and the utilities start buying reactors in large quantities.

Price is happy about the company's post-strike labor position. Morale has been restored and there have been no work stoppages since October 29. Moreover, Westinghouse can do more things in its plants that make for efficiency of production.

MERGERS, ACQUISITIONS and FINANCE

Robertshaw-Fulton Controls has purchased **Beta Corp.** of Richmond, Va. Beta's operations, the manufacture of vibration controls, will be moved to Philadelphia and consolidated with Robertshaw-Fulton's Fielden Instrument division.

Robertshaw-Fulton has also agreed to acquire **Acro Manufacturing** of Columbus, Ohio in exchange for 149,130 shares of its common stock.

Thomas A. Edison and **McGraw Electric** recently merged into one of the largest electronic-electrical firms in the nation.

The merger was worked out through an exchange of stock and split of shares. McGraw stock was split two for one and Edison stockholders will receive one share of McGraw for each share of Edison common. The combined companies will be known as McGraw-Edison Co.

Fidelity Amplifier, Chicago has purchased the Godfrey Manufacturing Co. producer of intercommunication equipment. The price was not disclosed.

Magnecord, Chicago will be operated as a division of Midwestern Instruments, Tulsa if stockholders approve merger plans. Terms of the agreement call for an exchange of securities with issuance of Midwestern Instruments common in exchange for all Magnecord common stock. American Research and Development Corp., Boston is a major investor in Magnecord.

Vitro Corp. of America has agreed to purchase Berkshire Chemicals of New York, chemical sales organization. The new subsidiary will handle sales for two Vitro divisions, Vitro Manufacturing Co. and Vitro Rare Metals Co.

Topp Industries, Los Angeles has announced the acquisition of Heli-Coil Corporation, Danbury, Conn. Topp issued 100,000 shares of common stock and $900,000 of 3-percent convertible debentures to purchase Heli-Coil and also paid $500,000 in cash. Heli-Coil will be integrated as an entity in Topp Industries.

New Precision Machine Cuts, Slices, Dices Semi-Conductors, Other Hard, Brittle Materials

Standard DoALL MICROTOMATIC machine employes very thin diamond or abrasive wheels to machine accurately to ±.001″ with excellent finish and minimum material waste; handles germanium, silicon, quartz, ferrites, ceramics, tungsten, carbide, hardened steels, other materials.

Major time and material savings in cutting off, slicing, parting and slotting of hard, brittle and fragile materials are being accomplished with new DoALL Microtomatic machines. Typical applications include production of wafers for transistors and oscillators, parting of transformer cores, slicing of metallographic test specimens and cutting off of ceramic inserts for cutting tools. Until the development of the Microtomatic, there was no standard "packaged" machine designed and fixtured specifically for the exacting requirements of such applications.

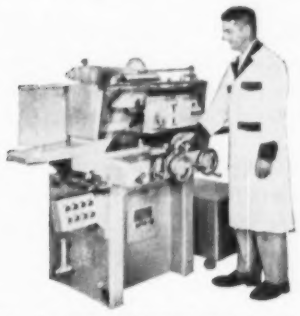


Fig. 1—MICROTOMATIC Model MTA-6 —smooth, powerful table drive, controlled feed rate, automatic indexing, ample spindle power, lubricated ways —ready to use without modification.

While developed particularly to machine hard, brittle materials, the Microtomatic should be considered wherever it is practical to combine precision stock removal with production of a ground finish.

Slicing and Dicing Transistor Wafers

Slicing of germanium or silicon ingots into wafers ranging from .010″ to .030″ thick is accomplished with very thin diamond wheels, from .015″ thick x 3″ O.D. to .028″ x 6″. Use of small diameter and, hence, very thin wheels is made possible by rotating the ingot. The narrow kerf greatly reduces waste encountered in methods where larger diameter and, hence, thicker wheels must be used. Production rate in slicing of an ingot approximately 1″ x 3″, for example, is 50 cuts per hour. Accuracy of index is ±.001″, parallelism ±.00025″, surface finish 4 to 5 microinches rms.

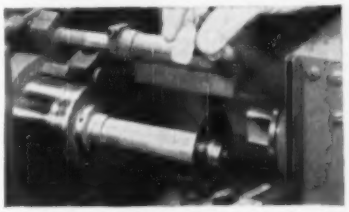


Fig. 2—slicing germanium.

Dicing of the wafers is accomplished by a series of thin wheels mounted on the spindle—Fig. 3.

Cutting-off Quartz for Oscillators

The machine setup for slicing quartz wafers is the same as in Fig. 2. Slices as thin as .0065″ are cut at a table feed rate of .060″ per minute, slices of .010″ to .015″ are cut at .125″ per minute. Parallelism is maintained at ±.0002″.

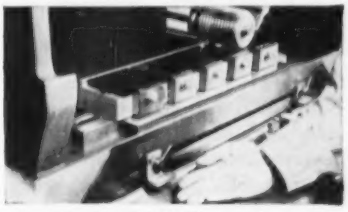


Fig. 3—dicing silicon wafers.

Parting Transformer Cores; No Grinding Required

Fig. 4 shows an excellent application of the Microtomatic wherein transformer cores are cut in two parts. Accuracy and finish are such that expensive time-consuming secondary grinding and lapping operations are entirely eliminated. Diamond saws are used to part sintered ferrite cores; abrasive wheels are used on silicon steel wound cores.

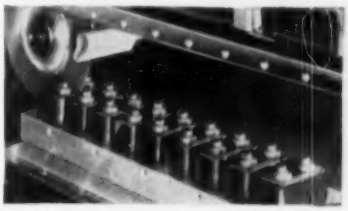


Fig. 4—Parting transformer core.

Typical Users

Among the companies using DoALL Microtomatic machines for electronic parts manufacture are:

General Electric Company; Westinghouse Electric Corp.; Bendix Aviation Corporation; Philco Corporation; Delco-Remy Division, General Motors Corp.; Sylvania Electric Products, Inc.; Minneapolis-Honeywell Regulator Co.; Hughes Aircraft Company; National Semi-Conductor Products; Battelle Memorial Institute; Pacific Semiconductor.

See it Now—or Submit Samples

A DoALL Microtomatic machine may be seen in operation at the DoALL Technical Institute, Des Plaines, Illinois, where customer samples are machined free of charge to determine production rate, finish, accuracy, fixturing required, etc. See a Microtomatic work or submit samples and requirements.

Literature and Data Available

Complete information and descriptive literature about DoALL Microtomatic machines is available upon request. Call your local DoALL Service-Store, or write:

SPECIFICATIONS – STANDARD MODELS

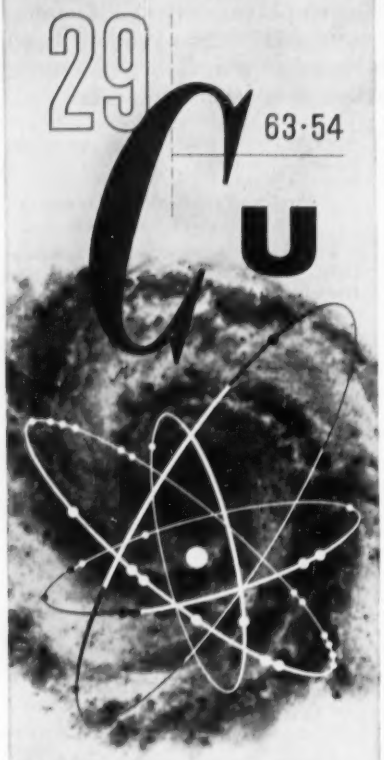
Model	MTA-6	MTA-8	MTA-10
Work Area	6½″ x 19″	8½″ x 24″	10″ x 30″
Wheel Size	3″, 4″, 5″ or 6″	8″ to 12″	10″, 12″ or 14″
Max. Vertical Adj.* Spindle Center to Table	16″	17½″	19½″
Longitudinal Feed Rate	1/16″ to 50 FPM	1/16″ to 70 FPM	1/16″ to 70 FPM
Auto. Cross Index	0 to .250″	0 to .250″	0 to .250″
Rapid Cross Traverse	0 to 75 IPM	0 to 75 IPM	0 to 75 IPM
Spindle Speeds	7000 RPM	2400 RPM	1800 RPM
Floor Space	46″ x 91″	65¾″ x 106″	69″ x 131½″
*with splash guards installed vertical adj. restricted to:	Min. 3″ Max. 9″	Min. 4″ Max. 11″	Min. 5″ Max. 13″

THE DoALL COMPANY

Des Plaines, Illinois

GR-20 *Machine Tools . . . Cutting Tools . . . Gages*

ACCEPTED SYMBOLS



Symbol for copper . . . the element whose high heat conductivity makes it ideal for the grids in electron tubes.

Just as Cu is the accepted symbol for copper, so Tung-Sol represents the highest quality production of electron tubes to volume requirements. This faculty is a major reason why Tung-Sol is America's largest independent electron tube manufacturer.

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Manufacturers of Automotive and Electronic Components

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WASHINGTON report

THE MARKET for ultrahigh frequency television equipment may be taking a turn for the better now that FCC has made its first decisions on deintermixture. The commission has tentatively approved station switches in 14 cities—some will be uhf, others all vhf, others will have both types.

Some of the decisions grant channels to uhf applicants, others lift restrictions on uhf applicants who have already had their allocation approved. There's a good chance, still, that some of the decisions favoring uhf applicants will be taken into court by vhf competitors.

The spotlight on uhf—which has had hard going—also gives new emphasis on current industry studies on how uhf telecasting can be made more effective. The main one in progress is that of a new joint industry coordinating group, TASO—Television Allocations Study Organization. Backed by FCC and composed of trade associations, TASO is conducting research on transmission lines, transmitters, antennas, receiving equipment and propogation data. TASO is made up of four associations of broadcasters and manufacturers.

The Association of Maximum Service Broadcasters (mainly vhf interests) is a member of TASO. But it is also conducting its own $120,000 study on the field intensity of existing uhf operations, which it will turn over to TASO. Both studies are due to be completed by the end of the year.

Meanwhile, FCC has told many stations already authorized but not yet built (mostly uhf's) that it will not tolerate further delay in starting operations. This may stimulate the uhf-equipment market. But uhf operators may still drag their heels before beginning new facilities.

ICBM-IRBM get priority

New Commerce Dept. Regulations require electronics producers and other suppliers to give top priority to orders for components and other materials used in the military ICBM-IRBM program. Up to now, ballistic missiles rated on a par with aircraft, atomic weapons and other defense goods. Under the new rules, ICBM-IRBM contracts and purchase orders will carry DX-ratings—taking priority over all other orders and requiring suppliers to report acceptance or rejection of the orders within 5 days.

Government funds for private electronics technical training institutes may be in the offing, if the president's Committee for Development of Scientists and Engineers has its way. The Committee is asking regional collegiate accreditation organizations to see what they can do about recognizing the technical institutes. Only with accreditation can they qualify for U.S. funds which are available to other kinds of schools.

Britain may cut back her guided-missile production program if a cooperative deal can be worked out with the United States. The specifics are highly classified, but British officials are talking with U.S. officials along these lines: Britain, to cut the burden on her budget and her scientists, would integrate her guided-missile research with ours; U.S. would produce the missiles and supply them to Britain. Political reaction could be violent both here and there; but it could go through if Eisenhower gets behind it.

Differential pay in favor of skilled technicians in the military services is being pushed as a solution to the manpower shortage. The Air Force, particularly, is suffering. Electronic technicians would get higher pay than line soldiers, sailors or airmen.

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- **automation**
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PURPOSE OF THE DIVISION

The new Special Engineering Products Division has been created to enable IBM to apply systems knowledge, engineering and production skills to organizations seeking assistance on specific problems connected with the processing of industrial, commercial and scientific data. Its engineers will design, fabricate and install tailor-made systems for such applications as engine test stands . . . wind tunnels . . . flight test . . . industrial process control . . . machine tool and material handling control . . . nuclear reactors . . . innumerable others.

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It should be emphasized that the new Division has the responsibility for developing and building equipment related to, *but outside of*, IBM's regular line of products. The variety and diversification of projects call for ultimate creativeness to *develop nonstandard* computing and data-handling components, machines and systems for tie-in with existing IBM equipment.

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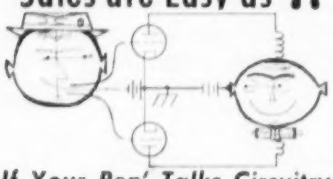

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EXECUTIVES in the news

GE's general manager of defense electronics George Haller, left, and associate Richard Raymond

CURRENTLY reorganizing GE's Defense Electronics division, general manager George L. Haller fills one of the three pairs of shoes left vacant by soon-to-be-retired GE v-p W. R. G. Baker.

Haller worked with the Army from 1935 to 1946. He was coinventor of an aircraft antenna reel used almost universally during the war, worked on radar countermeasures (for which he got the Legion of Merit).

After leaving the Army, he returned to his alma mater, Pennsylvania State University, to become assistant dean and later dean of its College of Physics and Chemistry. While dean, he formed the consulting firm of Haller, Raymond and Brown, and patented an aerial electronic camera now being produced by HRB.

Haller is active in enough technical, fraternal and other groups to weigh down three people, still finds time to delight in the rearing of his daughter. As a relief from all his war planning and other activities, he raises flowers, is a life member of the American Orchid Society.

Strictly PERSONAL

Editor:

The electronics industry is badly inbred. The doors of the research labs are locked, so that nothing can get out—but nothing gets in, either. If it weren't for turnover in manpower, there are some labs that never would have a new idea.

We try to patent laws of nature as if they were journeyman's 'techniques. Our patent laws weren't meant to cover something like a research lab. The results of basic research are supposed by many to be the property of all men. The gifts of nature are a common heritage, not a proprietary inheritance. . . .

Has anyone ever considered that this frame of mind alone might be keeping a lot of young people out of the technologies? It may be

wildly idealistic, but many young scientists don't relish the idea that their minds are just so many gadgets to be traded on the open market for so much cash.

STEVE WOREY, JR.
NEW YORK, N. Y.

Dear Sir:

Everybody talks about the shortage of competent scientific people, but no one wants to trace the problem. As a teacher, I wonder whether the watering down of the public-school curricula isn't to blame.

College professors say they get students who are completely unready for the discipline of the sciences. High schools are partially to blame, but the raw material they get to work with is pretty shoddy, too.

We've become so concerned with mass-producing people with diplomas, degrees and mortarboards, that we've forgotten to produce some educated citizens. It's a dangerous situation.

MARY C. POWERS
MT. EPHRAIM
NEW JERSEY

Dear Sir:

. . . There is every indication that more elaborate controls will be used in future cars. Electronic controls, due to their greater sensitivity, may be used for fuel injection, and may replace hydraulic controls for automobiles, such as those used presently in transmissions.

In the long-range future, there will be more electronic warning devices for highways, such as radar for bad weather. Future . . . engineers may devise electronic systems to automatically guide cars on turnpikes. Unlike a control system actually being tested in a branch of the Paris subway system, which uses grids for control, it is more likely that ultrahigh-frequency radio signals will be used to guide cars and control speeds. . . .

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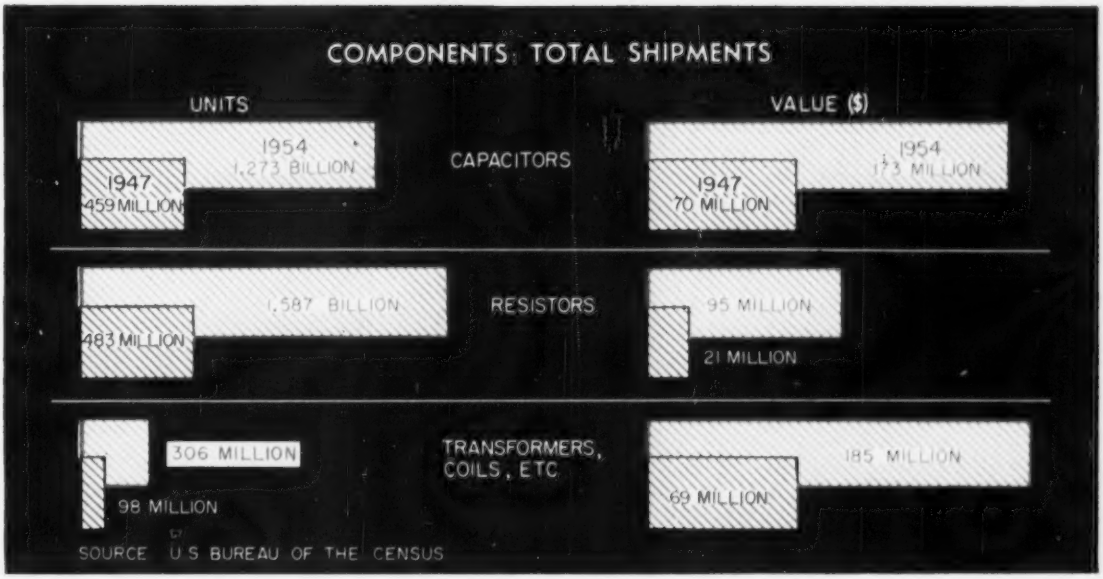
business edition
FEBRUARY 10, 1957



PRICES of electronic components outrun production savings as . . .

Accent shifts in COMPONENTS

Users need special designs, precision parts and reliability
Skilled hand labor ups costs; packaged circuits may help
Producers see industry overhaul, more automatic operations

COMPONENT MAKERS are being devilled by a little man with a three-pronged fork. The little man is the customer, who will buy half a billion dollars worth of components this year. The three prongs are his needs: price, precision-plus-reliability and adaptability to automatic assembly.

Demand for components is soaring, even as their price is rising. For example, industry used less than 400 million fixed-composition resistors in 1947, gulped down last year's record production of 1.5 billion. Average unit price has increased more than 30 percent in nine years.

User requirements force costs up, user resistance tends to pull prices down. Component manufacturers are caught in the middle. The packaged circuit or module could mean more profit dollars in

the component manufacturers' pockets. But its present use is limited, and production is small.

Clarostat president Victor Mucher spotlights one side of the producer's problem. He states that the accent is now on quality rather than quantity. "We are called upon to meet lab and instrument-shop standards," he says.

Mucher adds that quality components sometimes mean higher dollar volume and wider profit margins. "Component manufacturers," he points out, "are getting the best break in years, for the radio-tv business with its large volume and small profit no longer dominates our industry."

Other producers feel that the industry's underpinnings are shaking. Centralab's president W. S. Parsons says that transistors are overhauling the whole concept of circuit design. "The component industry will have to overhaul itself accordingly," he warns.

Equipment manufacturers' need for production short-cuts provides a headache for component makers. Customers invest $250,000 or so in an automatic assembly machine, find that it won't work with off-the-shelf components. Machines often need special shapes and designs within strict physical tolerances. Parts jam up in the feed channel if they aren't all the same size.

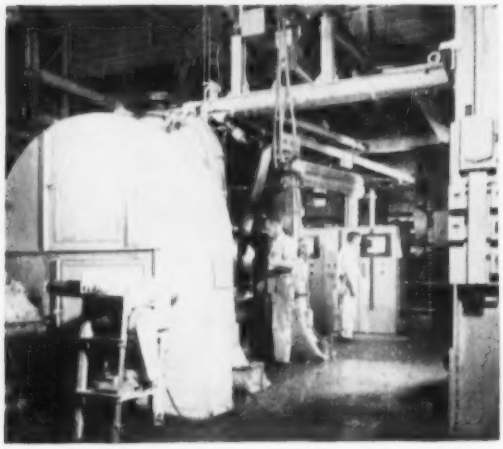
"Our industry," says Cornell-Dubilier's P. McKnight Deeley, "grew up because it was able to produce cheap parts in quantity. If we could retool and make these special components by machine it'd be no problem. But usually we have to do a lot of hand labor."

Another production shortcut: packaged circuits, such as Centralab's PEC (packaged electronic components) and ACF Electronics modules. Such packages place manufacturing and some assembly problems in the hands of the component people.

Industry comments reveal the two edges on the sword. "If you get a good supplier," says Dorman Israel, executive vice president of Emerson Radio, "your line rejects are cut way down."

A Motorola spokesman agrees, but adds "Once you've got them you're stuck with them." The cost of redesign while equipment is in production goes up, since the engineer is forced to design around the package as he would around a tube.

Beta rays check TIRES



BETAMETER containing 1,000 electronic components and parts keeps rubber thickness uniform during tire fabric calendering at Goodyear plant. Made by Isotope-Products, it measures fabric's resistance to beta rays

RECTIFIER pattern shifts

SELENIUM supplies have caught up with market demand just in time to see the electronics industry's demand level off. A half million pounds (half the domestic production) went to the electronics industry last year, as it did in 1955.

One trend in rectifiers seems to be toward silicon and germanium. Experimental work is also going on here and abroad in intermetallic materials. Irving Green of Green Rectifier, N. Y., identifies aluminum-antimony as one of the main contenders in this group. Interest has been shown also in gallium-arsenic devices.

At least one producer of selenium rectifiers is enthusiastic about Germany's relatively new Siemens vacuum-evaporation process which requires less selenium per rectifier, thereby reducing cost. The product apparently is half the size, has higher efficiency and longer life than previous selenium rectifiers. Siemens has licensed and equipped Radio Receptor to use the process, with production expected this month.

Westinghouse is cross-licensed with Siemens but is not yet using the new selenium process. Present plans are to begin a pilot run of a few thousand silicon rectifiers for tv and radio receivers next month. 100-percent use of silicon rectifiers is the ultimate aim.

GE is producing germanium rectifiers for tv and radio receivers and plans to use more germanium in replacement parts.

Sarkes Tarzian's George Farnarrino says: "We will soon be producing 50,000 silicon rectifiers a day."

TV SETMAKERS retrench

Inventory-laden industry seeks higher profit margins
Modular design and mechanical assembly may help
Pin future hopes on color sets and transistor portables

RETURN to better profits despite warehouses bulging with some 2.5 million sets is number one goal for the tv set manufacturing business. Manufacturers' inventories are higher by some 300,000 sets than at year's end 1955. Industry leaders attribute slim profit margins to overproduction, underpricing and to the sale of some 2.5 million low-profit portable tv sets.

• Motorola's Bob Galvin says, "The biggest single influence on profits is poorly managed planning by tv manufacturers, who have built many more tv sets than required by the market."

• Zenith's Len Truesdell points out, "Manufacturers must produce collectively for market demand and not ruin the industry every six months with liquidations which beat down the price level."

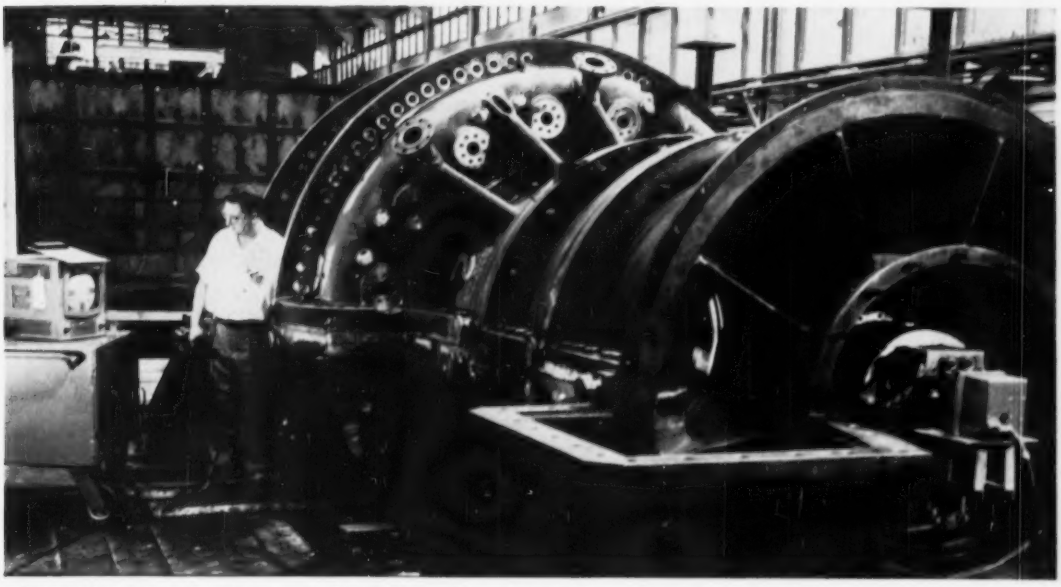
He adds that sets are priced some 10 percent too low in the market.

• Frank Freimann, Magnavox president, sees portable tv as a profit-smashing ogre: "During recent months, the industry's dollar volume took a sharp decline, with resultant shrinkage of profits due to the high percentage of sales of small-picture sets at low prices."

TV producers are making well-hedged estimates of coming production for monochrome and color sets. Most feel that 7 to 7.2 million sets will go over consumer thresholds this year. Of that number, 2.5 million will be portables, and some 300,000 to 350,000 will be color sets.

Cards are being held close to the chest when the discussions turn to one-gun color tubes, anticipated

INDUSTRIAL tv aligns turbines



SECTIONS of 16,500-kw gas turbine being aligned with aid of GE industrial tv system. Camera (right) is focused on a centered target in each shell. The operator is guided by target position on receiver

production, advertising plans, use of automatic production machinery and the effect of automation on component design and price.

The major emphasis on screen size in 1957 is expected to be on 21-in. units, and monochrome portables of 14 and 17-in. size. Color tv will still concentrate on the 21-in. tube.

Modular construction, strong in portable radio, is being used more and more for tv, especially portables.

- Motorola uses 17 modular plates containing units equal to 127 conventional components attached to a printed circuit chassis in a 17-in. portable.

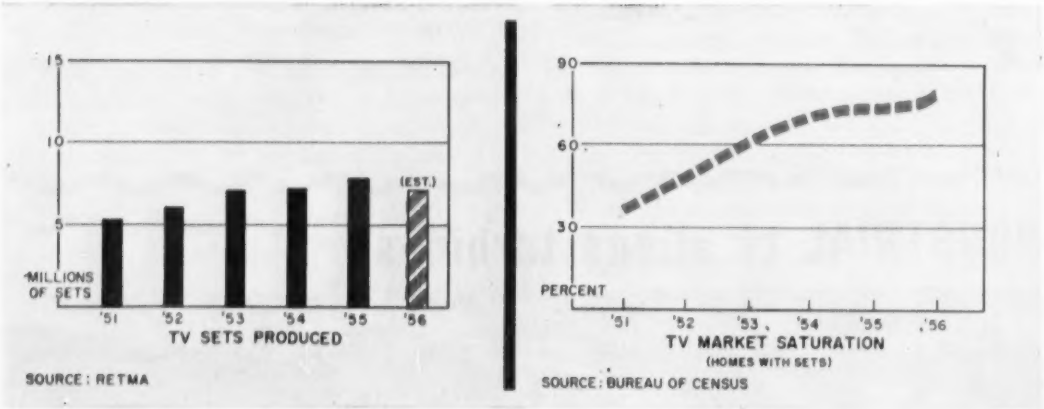
- Emerson is using chassis incorporating a horizontal deflection circuit made of four modules which equal 40 components.

Color tv may prove to be a big item later in the year, and some manufacturers believe not only RCA but others may give a strong advertising and promotional push to the sets.

Limited production may, however, leave producers with little initial profit from color sets. Price reductions seem to be ruled out until late 1959 at the earliest. Sales last year in some major cities saw color tv sets going for $395 and, in a few instances, for $295.

Transistorization of tv sets is discounted by producers for this year. Most say they are holding off because transistors are relatively more expensive than tubes. Transistors will see plenty of action, however, when fully portable, lightweight, battery-operated sets are placed in mass production.

PRODUCTION and SALES statistics



Last year tv set producers turned out sets at a rate only slightly below the 1955 peak. Total set production in 1956 was about 7.2 million units, eight percent below the 7.8 million produced in 1955.

Maintenance of production near these levels this year will depend largely on replacement sales as the first-set market approaches saturation. Since 1951 the percent of homes with tv sets has increased from 38.6 to about 80.

With set prices continuing to fall, dollar volume dropped more sharply than unit production in 1956. The retail value of sets produced last year was about $1.4 billion, 22 percent less than 1955 sales of $1.7 billion and 32 percent less than the 1953 high point of over $2 billion.

Decline in selling price was influenced by growth of the low-priced portable set market. The average retail selling price in 1956 was about $190, a drop of $35 from 1955.

There is some fear of a production cut back in the first quarter. Layoffs of production workers have been reported in the industry. Motorola president Robert W. Galvin estimates that 1957 set sales will be 300,000 below 1956.

RETMA reports sales of 9.4 million transistors worth $7 million dollars in the first 10 months of 1956. Texas Instrument predicts production of 400 million transistors worth $225.5 million by 1965.

Picture-tube sales for the first 10 months of 1956 amounted to 9,234,000 units with a value of $166,782,000 while receiving-tube sales for the same period amounted to 390,357,000 units with a value of $313,599,000. Government agencies are concerned over ability of the receiving, transmitting and special-purpose electron-tube industries to meet military and civilian requirements under full mobilization.

How to evaluate a RESUME

Electronic engineers scarce as hen's teeth
But "buying pig in a poke" is always bad business
Resumes tell a lot, if you read between the lines

YOU DON'T need a scale to weigh a resume. But here are some measuring-points you may find useful:

Look for signs of progress in the applicant's career. Notice how he expresses himself. Is he a long-term employee or a "jumper?"

These are some of many points stressed by personnel executives with Massachusetts electronics firms.

Every working day they evaluate resumes. They discuss this important phase of their task this way:

"How a fellow expresses himself on paper tells me if his mental processes are logical." Abbott H. Nile of Raytheon is speaking.

"For the same reason, I also note how he organizes his record."

A man's job objective is a good barometer.

"That is the first thing I look for," says Dorothy G. Cooley of Baird Associates-Atomic Instruments in Cambridge. "It's a favorable factor when a man knows what he wants. Then we can decide more easily if we want him."

However, a slick, professional-appearing resume doesn't sway Miss Cooley. Facts—what the man has done—are most important. She points out anybody can pay to have a super-duper resume written.

All personnel executives say they pick up every resume with one thing in mind: What does my company need?

Some firms interview good men even if they have no immediate openings.

"That's what we do occasionally," reports John D. Quackenbos at General Radio. "Even though we can't use him now, he might be a good addition for the future."

Security clearance is something to look for in a resume, if a firm does classified work.

Also: does the applicant have a sensible reason for leaving his present position? "I give considerable weight to this," says Edward S. Barber of Sylvania.

There are definite danger signs to look for when reading a resume.

- Job-hopping. This indicates instability. Among young people, look for school-jumping.

- Unexplained gaps. There's a reason for each. Occasionally, it is valid—such as sickness. But most times a gap shows a weakness. If a man didn't stay long elsewhere, he probably will leave you, too.

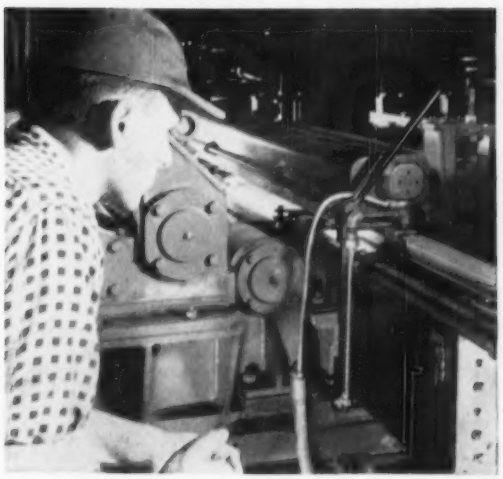
- A "know-it-all" or an "I'm-not-sure." Both may be bad risks. Intelligent applicants know they don't know everything. But they usually are sure of what they seek.

A man too long in one field may be a bad risk for changing his spots. Even if he offers to accept a pay cut, he may not be happy.

Francis L. Mannix of Minneapolis-Honeywell is definite on this point.

"Two things will work against him. He will have to live on less and he will have the pressure of learning a new field."

Tubes detect PINHOLES



SCANNING system made by GE detects pinholes in strip steel up to 0.01 inch thick. Holes can be seen at speeds to 2,000 feet per minute. Scanner uses 3,000-watt mercury lamp and six multiplier phototubes

TI PROGRESS REPORT ON MILITARY TRANSISTORS

FIRST silicon transistors meeting NAVY SPECS

For *reliability* under *extreme* conditions... design with TI's military silicon transistors... built to give you high gain in small signal applications at temperatures up to 150°C. Made to the stringent requirements of MIL-T-19112A (SHIPS), MIL-T-19502 (SHIPS), and MIL-T-19504 (SHIPS) — these welded case, grown junction devices furnish the tremendous savings in weight, space, and power you expect from transistorization... *plus* close parameter control that permits you to design your circuits with confidence.

All 20 Texas Instruments silicon transistor types have proved themselves in military use. First and largest producer of silicon transistors, TI is the country's major supplier of high temperature transistors to industry for use in military and commercial equipment.

degradation rate tests for TI's USN-2N117, USN-2N118, and USN-2N119

test	condition	duration	end point at 25°C
lead fatigue	three 90-degree arcs	—	no broken leads
vibration	100 to 1000 cps at 10 G	3 cycles, each x, y, and z plane	I_{CO} = 2 μA maximum at 5V
vibration fatigue	60 cps at 10 G	32 hours, each x, y, and z plane	h_{ob} = 2 μmhos maximum
shock	40 G, 11 milliseconds	3 shocks, each x, y, and z plane	h_{fb} = −0.88 minimum (USN-2N117)
temperature cycle	−55°C to +150°C	10 cycles	h_{fb} = −0.94 minimum (USN-2N118)
moisture resistance	MIL-STD-202	240 hours	h_{fb} = −0.97 minimum (USN-2N119)
life, intermittent operation	P_c = 150 mW, V_c = 30V	1000 hours, accumulated operating time	
life, storage	150° C, ambient	1000 hours	
salt spray	MIL-STD-202	50 hours	no mechanical defects interfering with operation

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pioneer producer of silicon transistors

TEXAS INSTRUMENTS
INCORPORATED
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ULTRASONICS: $15 million

Estimates range as high as $25 million
Makers look for 25-percent gain in 1957
Uses include: cleaning, testing, soldering, grinding, cutting

ULTRASONIC EQUIPMENT designed for industrial and medical use is carving itself an important slice of the electronics business. Manufacturers place 1956 sales at $15 to $25 million and expect a rapid rise.

One company sales manager reports that people in many industries are asking for demonstrations unsolicited. Relatively few had heard of ultrasonics a year ago, he asserts.

Ultrasonics' popularity stems from dramatic labor and material savings. One installation, at Sperry Gyroscope, cut bearing assembly cleaning time from two minutes to six seconds while reducing rejects to six in 1,000.

Many industrial uses depend on the forces created by cavitation or tearing apart of a liquid vibrated ultrasonically. This produces a scrubbing action which is put to work cleaning and degreasing odd shapes and confined spaces, drilling or grinding with abrasive slurries. In fluxless soldering, or tinning, the molten metal acts as the cavitation liquid.

The drilling-grinding technique allows cutting unusual shapes and holes in brittle materials and metals.

ULTRASONICS cleans computer gear assembly

The electronics industry itself uses ultrasonic cleaners for transistors and many subminiature parts and assemblies. Ultrasonic cutters are used to slice quartz and semiconductor crystals.

For nondestructive testing, variations from a prescribed resonance frequency indicate a faulty part. Other industrial ultrasonic devices include liquid-level sensors and intruder detecting systems.

Cleaning, testing, tinning, soldering, drilling, grinding and medical uses are most popular today.

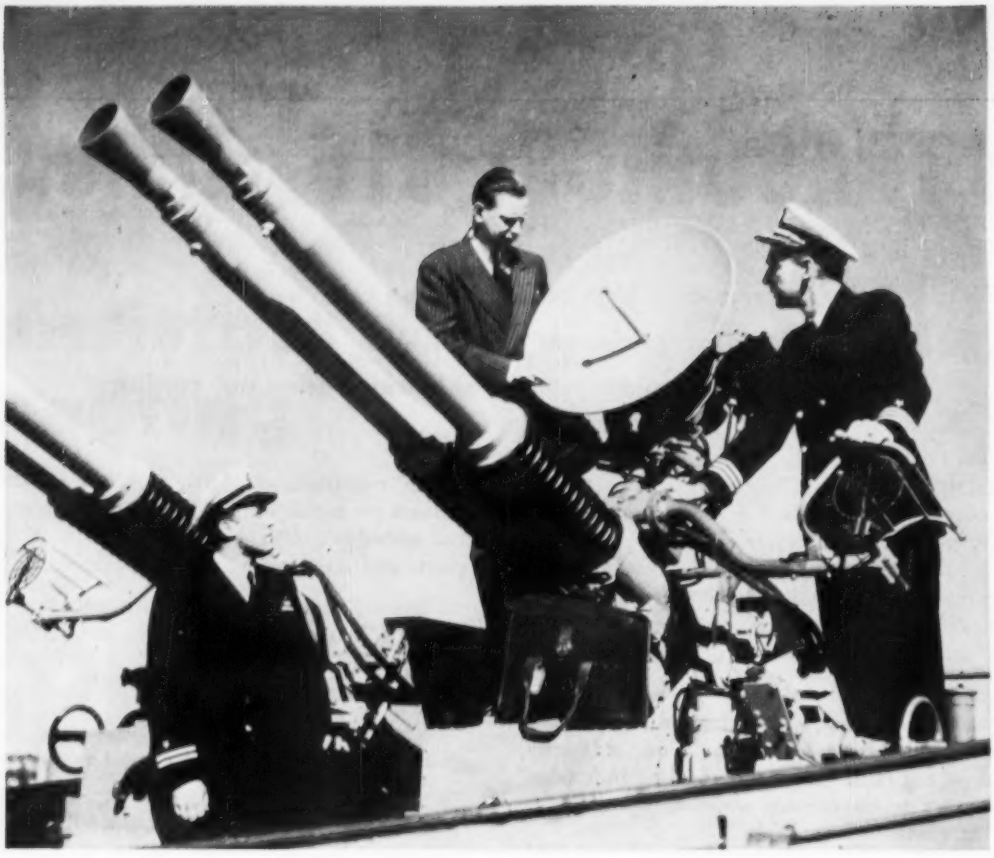
Manufacturers are bullish in 1957 sales expectations. Acoustica Associates hopes to sell $1 million worth of a new liquid-level sensor. American Hospital Supply sees a market for 500 hypodermic cleaners at $2,000 each. Walter Kidde and Co. expects a 400-percent increase in its alarm-system sales.

Peter K. Bloch, Branson Instruments sales manager, says, however, most firms are still making specialty units, a lot of it custom engineered. His firm began ultrasonics manufacture in 1946 with two men. It now has 54 employes and sales increase has averaged 50 percent a year.

W. C. Pothoff, vice-president of Aeroprojects, looks for a 25-percent increase in 1957. Newer firms may double or triple, he said, but those already having substantial business do not expect to. Potthoff is president of the Ultrasonics Manufacturers Association. It incorporated last August and has 20 member firms.

Selling price of ultrasonic equipment is largely determined by the intended application and auxiliary equipment required. One firm's ultrasonic cleaner sells from $1,300 to $7,600, depending on power output.

A typical commercial ultrasonic generator has an oscillator, power amplifier and transducer. One 20-kc set uses six power tubes, four germanium diode rectifiers, two r-f filters, 32 capacitors, 26 resistors and a variety of electrical parts, including three transformers. A variety of transducer materials are used, including barium titanate and nickel. Nickel is often used for high-power work.



ENGINEERS of Western Electric's field force check radar equipment aboard U. S. Navy destroyer

Military REPAIR bills double

Armed Forces award more maintenance to civilian firms
Lack of skilled electronic technicians is one reason
Air Force's DEW line and Sage system swell total

MILITARY SPENDING for electronics maintenance by civilian firms will amount to more than $325 million in fiscal 1957. This estimate covers all electronics maintenance spending—even that not clearly spelled out in agency budgets.

The fiscal 1958 outlook is for a substantial increase, especially in Air Force spending.

The military services handle maintenance contracting in two different ways:

- Under contract technical services, the contractor sells man-hours of maintenance time and assigns his employees to work at military installations. Sometimes the contractor's men work on equipment produced by another manufacturer.

- Under package contract maintenance, the work is done under the contractor's direct supervision, frequently in his own plant. Usually it is done on equipment produced by the contractor.

In fiscal 1957, the Air Force will spend $45 million for contract technical services. Next year, it expects to spend $55 million.

The Air Force will spend $28.9 million for package contract maintenance this year on communications equipment and $36 million on airborne armament electronics. Another $15.6 million will be spent for engineering-installation work, mostly at radar sites.

Not included in these figures are maintenance and operation of the DEW line and Sage system. A contract has already been awarded to IT&T's Federal Electric Corp. to operate and maintain the $500-million DEW line for $85 million annually. A similar contract will eventually be awarded for

maintenance and operation of the $2-billion Sage system for $400 million annually.

Here are some typical Air Force contracts for electronic maintenance:

- Philco and RCA supply the services of civilian technicians to augment military units at Air Defense Command aircraft control and warning sites.
- Bendix and GE teams visit such sites periodically to do heavy maintenance on radar and communications equipment.
- Hughes Aircraft operates a depot repair facility for fire-control systems.

The Army Signal Corps stays away from large-scale contract maintenance work. Instead, it hires contract field technicians from companies like Philco, RCA, Emerson, International Electronics, Raytheon, Bendix, Western Electric and National Scientific Laboratories to do field maintenance work.

In fiscal 1957, the Signal Corps will spend $5 million for the services of 500 contractor technicians. That's $4 million more than was spent for such work in fiscal 1951.

Some of the men live at military bases, others go from one installation to another acting as trouble-shooters on electronics maintenance problems.

The Navy's Bureau of Ships is spending $7 million annually for the services of contractor electronics personnel. About half the men are used in shipyards and other domestic naval installations, the other half are assigned to the fleet.

Right now, the Bureau is trying to reduce the number of contractor technicians at shipyards. It has contracts with 15 companies—including RCA, GE, WE, Philco, Westinghouse, Federal Telephone & Radio and Hoffman.

The Navy's Bureau of Aeronautics has 15 contracts with electronics firms who supply field technicians. It spends well over $5 million for electronics maintenance, including costs under production contracts.

In addition it has a $1.6 million contract with Lockheed Air Service for overall maintenance and repair of R7V transport aircraft and a $3.3 million contract with the same firm for work on WV-2 early-warning planes. These contracts, however, are not exclusively for electronic equipment.

IRE Show: the biggest

During the week of March 18-21, some 50,000 engineers will troop through the biggest market place ever arranged. This year, the IRE Show will have 115,000 square feet of exhibit space. That figure is net. Columns and aisles don't count.

Around 1,200 booths put up by 840 exhibitors will be jammed into all the four floors of the huge New York City Coliseum.

Some 40 percent of the show will deal with components. Another 40 percent of the exhibits will be displays of end products. The remaining 20 percent to be devoted to hardware.

The show means different things to different people. Some go to buy, some to sell. Some go to renew friendships and some to stare. For many exhibitors the show is a major market. "The radio engineering show is the result of good radio-electronics design as expressed in products brought up to the minute," says Will Copp, exhibits manager.

Technical DIGEST

Greatly reduced problem-solving time for digital computers is expected as a result of a National Bureau of Standards development. By storing 500 to 700 digital pulses per inch of magnetic tape, computers are provided with data at a faster bit rate.

A 6,000-mc traveling-wave tube under development at Bell Laboratories will deliver 5 watts and have a bandwidth of 500 mc.

The thickness of walls can be determined by a GE-developed ultrasonic micrometer. The time interval required for sound waves to pass through the wall and be reflected back to the instrument is converted into an indication in inches.

Called a bigradient uniaxial microphone, new RCA device combines two uniaxial microphones in series opposition to increase the distance at which sound can be picked up 1.7 times that of uniaxial microphones. By discriminating against sounds that originate from the sides and rear, the microphone is useful for long-distance sound pickup for radio, tv and sound motion pictures.

A transistor oscillator will be used on each telephone on party lines in a system to be installed in Virginia by Federal Telecommunications. The frequency of the oscillator will identify the party making a toll call.

$3.3 BILLION for electronics

Military procurement makes up bulk of Federal spending

R&D may mean $½ billion worth of business

Six nondefense agencies to spend over $100 million

THE Eisenhower administration's spending program for fiscal 1958, beginning July 1, 1957, earmarks record sums for electronic equipment.

The military budget submitted to Congress plans at least $3.3 billion worth of expenditures—that is, actual delivery of equipment—for electronics in fiscal 1958. This compares with $3.1 billion in fiscal 1957, ending June 30, 1957.

The largest government procurement is for military aircraft and guided missiles. Pentagon officials estimate that roughly 25 percent of aircraft funds and more than 40 percent of guided-missile money are used to buy electronics equipment.

Aircraft electronics expenditures by the government will total about $1.6 billion in fiscal 1958, slightly over the current year's sum; missile electronics will amount to about $800 million, about $200 million more than this year.

An additional $927 million will be spent on other military electronics—ground communications, ground radar, fire-control gear for tanks and artillery and ground-to-air communications. Something over $200 million is included for shipborne communications and radar under the $1-billion Navy shipbuilding program.

In research and development, the Defense Dept. will spend $200 million for electronics projects in fiscal 1958, just about the same as current expenditures. These funds are for what the Pentagon calls direct-intention electronics.

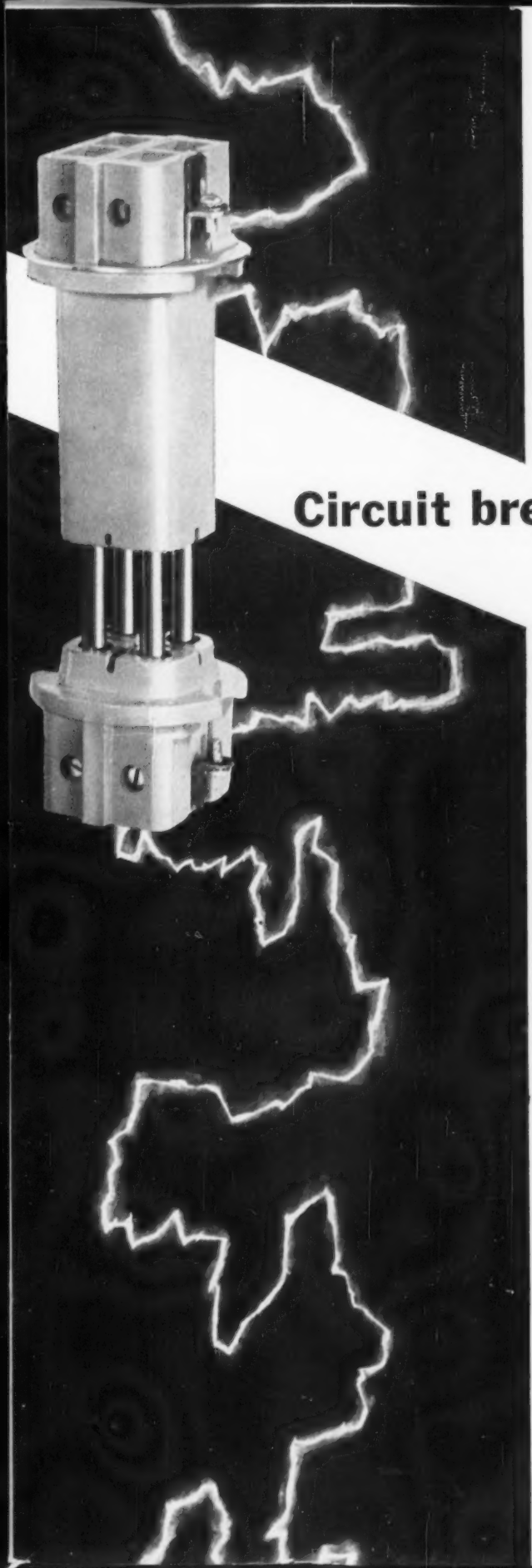
Presumably much of the $276.3 million earmarked for aircraft research and development and the $331.8 million for missile R&D will be spent on electronic equipment.

Outside the Defense Dept., this is how other agencies are lined up to buy electronic equipment in fiscal 1958:

- CAA will spend $69 million to convert its ground installations to the new Vortac distance and direction-finding systems.
- U.S. Information Agency requests $4 million for acquisition and construction of domestic radio facilities.
- Coast Guard seeks authority to spend money from a $5.4 million fund appropriated last year for construction of additional loran navigation stations. Supplemental funds will be sought later this year.
- Weather Bureau will buy $323,000 worth of weather surveillance radar.
- National Bureau of Standards will build a pilot electronic data-processing device to cost at least $100,000.
- Federal Civil Defense Administration will buy one million survey meters and about 15 million self-reading dosimeters out of its $75-million emergency equipment procurement fund.

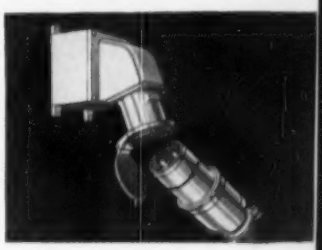
MILITARY ELECTRONICS SPENDING
(millions of dollars)

Aircraft (electronics 25 percent)	Fiscal 1957	Fiscal 1958
Army	$115	$109
Navy	1,595	1,645
Air Force	5,076	4,983
Total Defense Dept.	$6,786	$6,737
Guided Missiles (electronics 40 percent)		
Army	$425	$562
Navy	221	264
Air Force	860	1,213
Total Defense Dept.	$1,506	$2,039
Other Electronics & Communications		
Army	$142	$174
Navy	138	153
Air Force	646	600
Total Defense Dept.	$926	$927



Circuit breaking safety at full load...ASSURED!

High arc resistance determines choice of **RESINOX 3700** for new Russell & Stoll circuit breaking receptacles



The new R&S "SAF-T-ARC"® plugs and receptacles provide for complete circuit breaking. Safety is assured, even under overload.

The insulating bodies that house the electrical contacts in these units are molded of RESINOX 3700. Tests conducted by Russell & Stoll for high arc resistance show that RESINOX 3700 did not track or burn, even when subjected to 50% greater than rated loads.

Manufacturers of electrical parts profit also from the excellent moldability of RESINOX 3700, its elimination of scrap and other production problems, its high impact resistance.

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SAF-T-ARC: REGISTERED TRADE-MARK OF RUSSELL & STOLL COMPANY, INC.

Inland sailors buy RADAR

Top market is small commercial craft
Many large sets sold abroad
Domestic sales may rise in 18 months

Of the $7.3-million worth of commercial marine radar equipment sold by U. S. manufacturers in 1956, $5.2 million went for sets to be used on small vessels.

Radar has spread rapidly from ocean liners and freighters to small fishing vessels, harbor tugs, riverboats and even to craft used by the oil industry in the Gulf of Mexico. Radar enables experienced operators to distinguish between a rowboat and a buoy in the dark or to find their own slip in a fog-enshrouded harbor.

Manufacturers of radar for large sea-going ships sell more sets to foreign shipping lines than to domestic users. However, C. O. Iselin of Raytheon expects a national increase of a million dollars in the large radar set business in 1957. Sales will be divided between replacements for the domestic market and initial sales to some foreign ships. Increased shipbuilding in this country is expected to have a beneficial effect in some eighteen months.

An increase of $800,000 in sales to small-boat owners is expected in 1957. The boat owners you would least expect to use radar are the best prospects, according to Lavoie Laboratories. Vessels used on the Gulf of Mexico and on inland waterways are the greatest potential users. A few small radar units will be sold as standby sets for larger ships.

Even small radar units cost at least $3,000 installed. Despite the increased use of pleasure boats, only a small percentage can afford a radar set. Of the 150 or so yachts equipped with radar, most are corporation owned.

THEATER TV trips many

A handful of companies operate closed-circuit TV networks. They set up one-shot closed-circuit tv shows for stockholder's meetings, sales conferences, fashion shows and other similar events.

One has hooked up theaters for such entertainment specialties as championship fights and the Metropolitan Opera.

Like cheese nestled in a trap to entice mice, theater tv initially captured the imagination of many. The results have been painful to some. One estimate has it that some 15 companies have entered the field and failed.

Yet Theater Network Television and subsidiary Tele-Sessions, now eight years in the business, have produced a total of 123 big-screen shows. Sales and personnel meetings made up most of the traffic.

TNT owns more than $500,000 in equipment. It has 59 mobile projectors and has a few permanent ones installed in movie houses. Its biggest gross take was the Marciano-Moore fight: $1,300,000.

A recent company to try its hand is Closedcircuit Telecasting System, Inc. For a starter it ordered $250,000 worth of closed-circuit projection equipment. It intends to devote some of its energy in doing color shows, a theater tv rarity.

Sheraton Closed Circuit Television, formerly a subsidiary of the Sheraton hotel chain, is in operation. It is in the hands of Tele-PrompTer and known as the Group Communications Division. The firm has just ordered $1 million worth of GPL equipment.

Twentieth Century brought from Switzerland a device, called Eidophor, which would make a full-screen color picture possible. Eidophor was, perhaps momentarily, put aside when Cinemascope revived movie business.

Development of Eidophor, however, was continued by the movie company. Eidophor can now, says Twentieth Century, fill the Cinemascope screen with color tv.

FIRE RADIO needed

Fire departments need mobile radio. But small-town fire fighters often limp along dependent on police radio and in some cases on the telephone. Even 70 percent of the Civil Defense Mutual Aid groups—a string of small towns pooling fire equipment—are without radio communications.

Half of the cost for radio equipment for CD Mutual Aid group is met by the Federal Civil Defense Administration. Congress has set no limit on the total amount to be spent by the FCDA for this purpose. Only $5-million was spent in 1956 on mobile radio by Mutual Aid groups. This is the largest sum since the inauguration of the plan. The FCDA hopes this figure will leap upwards.

In an average installation, a single mobile unit would probably be installed for around $600. A base station would be somewhere between $800 and $5,000, depending on transmitter power output and antenna-supporting tower needs.

One example of how Mutual Aid towns operate and why they are going into radio is the network recently installed by GE in New England. Thirty five pieces of fire-fighting equipment in 46 communities are controlled from a central radio center in Greenfield, Mass. This is a big-city technique but it covers a rural area cut from the states of Massachusetts, Vermont and New Hampshire.

Leesona No. 108 Coil Winders wind coils for the ignition system of the Wright Cyclone Model R-3350 Engine. The system is designed and manufactured by the Scintilla Division of the Bendix Aviation Corporation in Sydney, New York.

At SCINTILLA DIVISION of BENDIX–Leesona® 108's wind Cyclone engine's ignition coils

When Bendix Aviation Corporation designed the ignition system for the Wright Cyclone Model R-3350 engine, they chose Leesona No. 108's to wind the coils.

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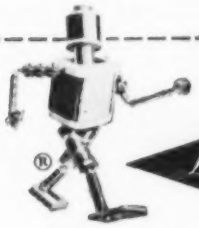

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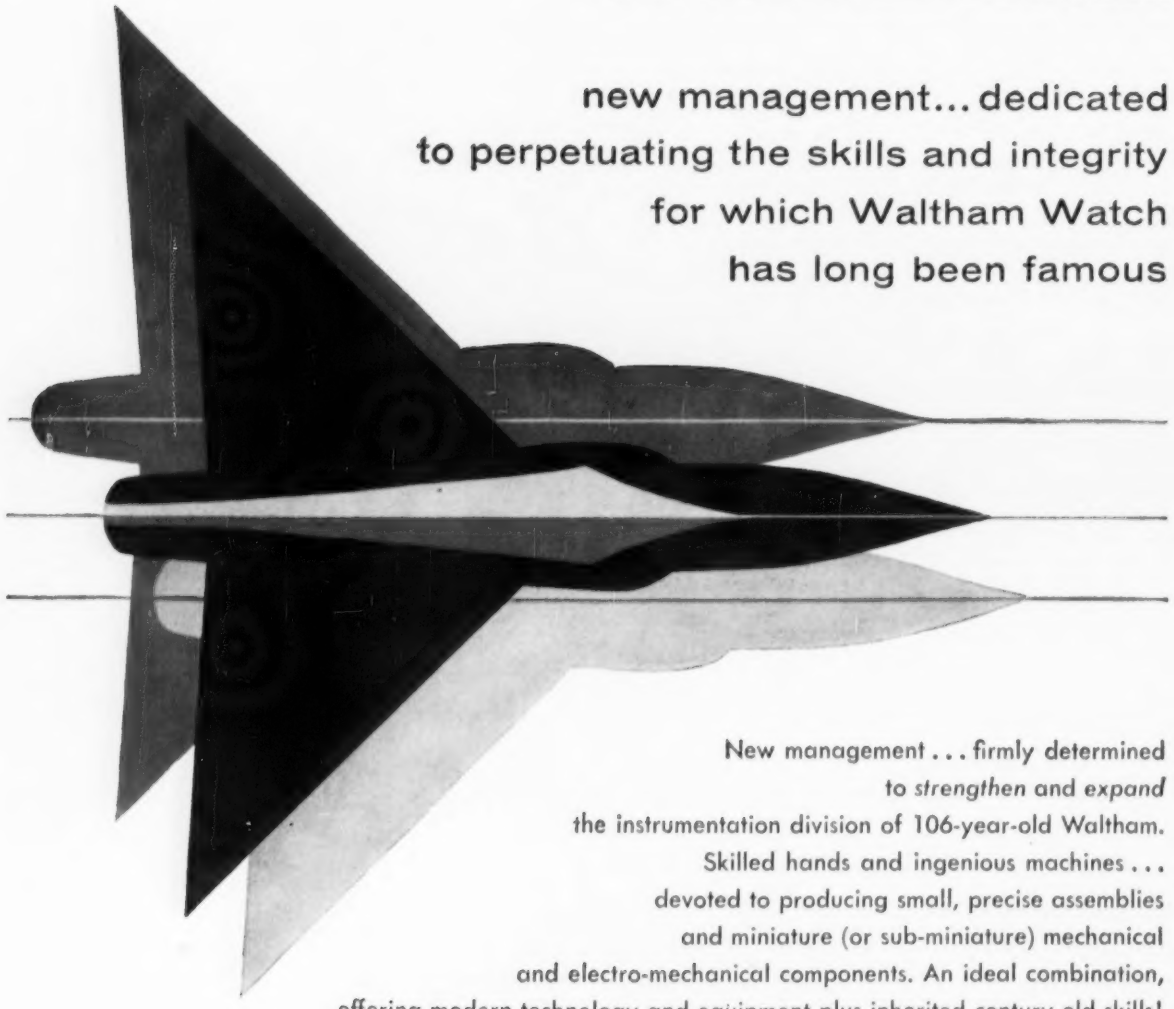

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Tool GAGE market grows

Auto and aircraft firms big customers
Precision machining sparks interest
49,000 prospect seen today

MARKET for automatic gage controls of machine tools, chiefly grinders, looms as one of increasing importance. "Virtually every machine-tool builder today produces machinery that can be equipped with automatic gage controls," says Pratt & Whitney's gage section head, W. C. Mullin.

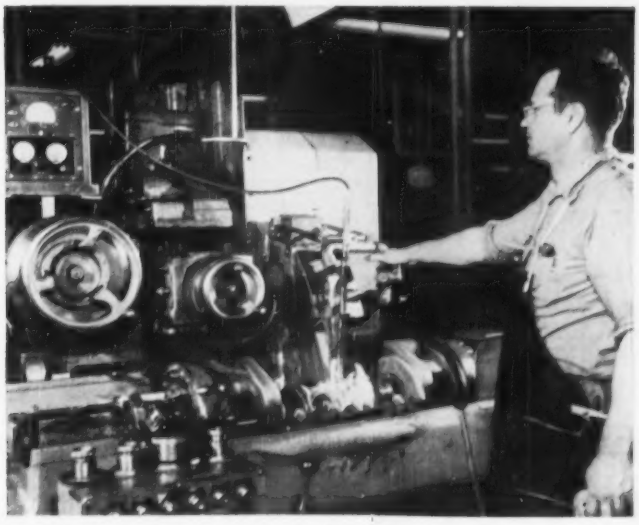
Growing needs to produce to closer tolerances and efforts to reduce costs through labor savings and scrap reduction are sparking the current interest in machine tool gage controls, reports the National Association of Machine Tool Manufacturers.

The automotive industry is one of the best customers for automatic gage controls. Auto makers have always been receptive to labor saving devices. Moreover, the trend toward higher powered cars is requiring them to produce to closer tolerances.

Another good customer is the aircraft industry. Production to fine tolerances is an ever-present problem of this industry. Narrowing margins of profit on military orders are making its members increasingly cost conscious.

One manufacturer estimates that there are about 49,000 immediate prospects for external plunge grinder controls—just one of many grinding machines susceptible to automatic gage controls.

Controls CRANKSHAFT grinder



AUTOMOBILE crankshaft grinding at Cadillac Motor Co. Attached Airborne Instruments automatic gage control continuously measures size of work during grinding

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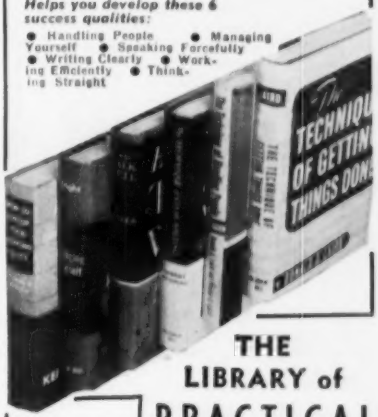

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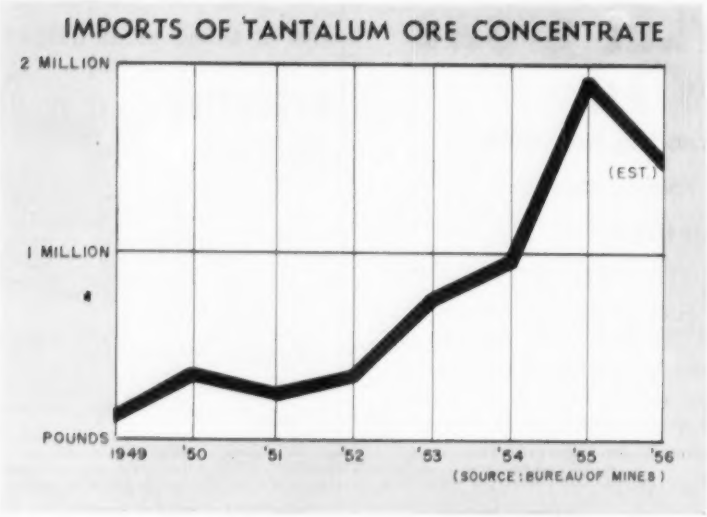


TANTALUM supply short

Miniature capacitors take half
Growth echoes transistor climb
Metal demand boosts ore imports

TANTALUM CAPACITOR production increased more in 1956 than all previous years combined, as quantities of the miniature components became available for nonmilitary uses. Makers are grumbling that consumption has outstripped supplies of tantalum metal.

There were 380 times as many tantalum capacitors made last year as in 1949, reports Fansteel Metallurgical. In 1955, production was 135 times 1949. Production began in 1949.

Over half of all tantalum refined goes into capacitors. Minor amounts are used in electron tubes and rectifiers.

Tantalum's value in capacitors stems from its ability to form a highly efficient dielectric oxide film. Tantalum is chemically stable and has a melting point near 3,000 C.

A four-microfarad, 60-volt tantalum capacitor takes up one-tenth cubic inch, or one-twentieth of a comparable paper capacitor's volume. Growth in use of tantalum capacitors has paralleled use of transistors and subminiature techniques.

Imports of tantalum ore concentrates rose from 330,000 pounds in 1950 to 1.9 million pounds in 1955 and dipped to an estimated 1.5 million in 1956. By comparison, the Bureau of Mines reports U.S.-produced concentrates totaled 1,000 pounds in 1950, 33,000 in 1954 and 12,500 in 1955.

ALUMINUM hits 1.7 million tons

SUPPLY of aluminum caught up with demand in 1956.

Reasons are record production and easing of government stockpile requisitions. The Office of Defense Mobilization called for 650,000 tons less in 1956 than in 1955 and none for the first half of 1957.

Aluminum prices rose during 1956 to 25 cents a pound for primary metal. Price was 17.6 cents in 1954, 23.7 cents in 1955.

Electrical and electronic equipment are the fourth largest consumers of aluminum. The Aluminum Association estimates 7.8 percent of the metal goes into this category. Alcoa figures it at 10 percent and expects the proportion will hold or increase even if aluminum production rises 50 percent by 1960. The biggest part probably goes into wire and cable. Electronic uses include chassis, antennas, frames, panels, capacitor plates and foil, tube caps and lightweight transformers.

Primary aluminum production hit 1.7 million tons in 1956. It was 700,000 tons in 1950 and 1.6 million tons in 1955. Expansion during 1956 raised production capacity to 1.8 million tons going into 1957.

SILICON prices drop $30 a pound

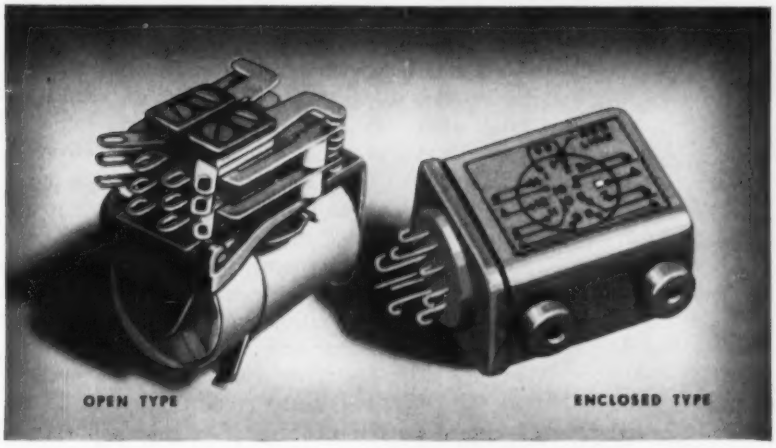
EXPANDING MARKET for semiconductor-grade silicon in the transistor and diode field is bringing about increased production, with accompanying price reductions.

Du Pont and Sylvania have cut semiconductor-grade unprocessed silicon price from $350 to $320 a pound. Price was $430 a pound in 1952. Du Pont expects further cuts as markets and production expand.

Processors must add controlled impurities before forming silicon into crystals. A big problem, says Morton Brozinsky, Semimetals president, is the tenacity of residual boron. The cost of silicon products—$30 a piece or more for transistors—restricts their use although they can perform with higher power and higher temperature than germanium, he said.

Solar-cell grade silicon was cut from $180 to $150 a pound. It is used in devices which convert sunlight into electricity.

R-B-M Miniature Multipole Relays of Proven Reliability



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APPLICATION: R-B-M Miniature Multipole Relays are used where the prime factors in switching electronic circuits are small size, light weight and reliability. These proven designs are produced for switching low power circuits, low capacitance circuits and power circuits. 125° C insulation now available on some versions. Coils can also be designed for plate circuit.

CONSTRUCTION:

Magnet Frame—Four sizes available on open type relays and three sizes on hermetically sealed type.

Contacts—Cross-bar palladium welded to nickel silver springs or button contacts on Beryllium copper springs.

Terminals and Mountings—Glass headers provided with either solder or plug-in type terminals with many various types of mountings available. Octal type plug-in headers can be provided on the HL enclosure. Plug-in terminals to fit either 9 or 14 pin standard sockets. Maximum of 14 pins for solder connections.

TYPICAL SPECIFICATIONS*

Open	Maximum Coil Resistance (OHMS)	Minimum Power Requirements Per pole at 25° C (WATTS)	Maximum Contact Form With rated current at 32 V.D.C. or 115 V.A.C. (non-inductive load)	Maximum Coil Watts	Enclosed
SM	9,000	.2	4 PDT 5 Amps. or 3 Amps. 6 PST 3 Amps.	3.75	HSM
SMD-2	9,000	1.0	SPNO Parallel Contacts Make 80 Amps. Break 20 Amps. at 32 V.D.C.	3.75	HSMD-2
SC	18,500	.16	4 PDT 5 Amps. or 3 Amps. 6 PST 3 Amps.	4.5	HPSC
SA	18,500	.14	4 PDT 5 Amps. or 3 Amps. 6 PST 3 Amps.	4.5	HLSA
SM-RF	9,000	.2	SPNO, SPDT, DPNC, SPNC, DPNO	3.75	HSM-RF HLSM-RF
SAD-2	18,500	1.0	SPNO Parallel Contacts, Make 80 Amps. Break 20 Amps. at 32 V.D.C.	4.5	HLSAD-2

*Other ratings and specifications available.

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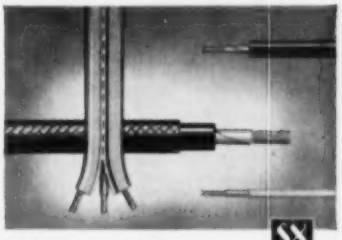

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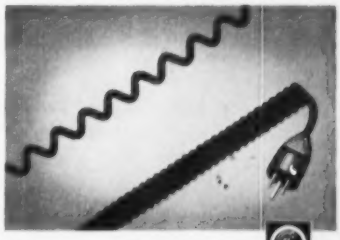
R-B-M "Control" Division



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ESSEX WIRE CORPORATION

30 firms push INFRARED

Detection equipment guides missiles
Use possible in aerial inspection
Cells in telescope detect star heat

INFRARED detection equipment for guided missiles, bombing, countermeasures, fire control and reconnaissance today is one of the hottest items in America's military research arsenal.

The list of electronics firms engaged in infrared work for the government is growing, but few contract awards are publicized. There are close to 30 companies now involved.

The speed and offensive power of jet aircraft and guided missiles have made infrared detection a vital factor in survival against possible attack by these weapons. For example, infrared antiaircraft equipment can pinpoint the hot exhausts of powerful engines and the high skin temperatures of airframes moving at great speeds.

Infrared detection systems for missiles such as the Navy's Sidewinder enable them to find their targets without producing energy that would betray their own positions.

Some idea of the potential of infrared systems for military use may be obtained from a recent statement by a British scientist, F. E. Jones.

Jones says the sensitivity of a modern lead sulphide cell is such that when one is mounted in a telescope it can detect the heat from stars. He adds that the fast response time and high sensitivity of the detectors makes it possible to detect small changes in temperature with a scanning system and thereby build a thermal picture.

One manufacturer claims to have produced 24 different infrared detecting systems for the Air Force, Navy Bureau of Aeronautics and the Army Signal Corps. All are under security wraps.

Reconnaissance systems and terminal guidance phase systems for missiles have also been developed.

An infrared reconnaissance system cannot be jammed by known electronic countermeasures or readily fooled by camouflage. Neither is its position revealed. Its ability to detect over a wide area suggests possible use for aerial inspection as called for in President Eisenhower's "open-skies" plan.

MILITARY electronics

RCA plans to establish a Special Systems and Development department to carry on research and development in such projects as airborne fire-control and missile launching systems, communications and data handling.

American Machine and Foundry expects substantial demand for its radar beacon, similar to the AN/DPN-19, for tracking rockets and guided missiles. The beacon's receiver picks up a single or double pulse-coded signal from ground radar. Its transmitter responds with a single pulse for tracking.

First of 16 destroyer-type vessels planned for the Navy's nuclear-powered guided missile fleet was commissioned last month. The *USS Gyatt* is the third Navy warship to carry the guided missile designation. The other two *Boston* and *Canberra*, are cruiser types. All three launch Terriers, electronic guided missiles.

Improved radiosonde, weather-sensing radio transmitter ejected from aircraft to determine weather characteristics in inaccessible parts of the world, has been developed by ARDC's Wright Air Development Center. New version, more accurate and adaptable than its predecessor, costs $80. Older version cost $100. Some 25,000 radiosonde are dropped each year by seven weather squadrons flying daily in the northern hemisphere.

CONTRACTS awarded

IBM has a $9,870,000 order from Air Materiel Command for the B-52's bombing navigational systems, optical and radar.

Elgin National Watch was awarded a $600,000 contract by the Navy Bureau of Ordnance for production of fuzes, safety and arming mechanisms and related items for the Sparrow, and for a still-classified missile.

Atomic Engineering Corp. of Grand Junction, Colo., has contracted with Rossford Ordnance Depot to supply low-voltage, heavy-duty test sets amounting to $202,157.

General Precision Laboratory has announced a contract of almost $17 million with Air Materiel Command for additional quantities of

AN/APN-81 and AN/APN-90 doppler navigation systems currently used in a variety of Air Force aircraft.

Sperry has been contracted by AMC for APN-59 airborne radar systems amounting to $6,471,402. Used for navigation and weather surveillance, the equipment has been ordered in great numbers for troop and cargo-carrying transports.

Curtiss-Wright has contracted with AMC to furnish engineering and technical data and installation services for C-121C flight simulators type MB-44, amounting to $1,007,753.

GE was awarded a $5,518,962 contract by AMC for world-wide contractual depot level maintenance and supply support of radar sets AN/CPS-6B, AN/FPS-6,-7,-8,-10, AN/GPS03, AN/GPA-37, AN/MPS-11,-14, iff and video mapping equipment, and other associated back-up material.

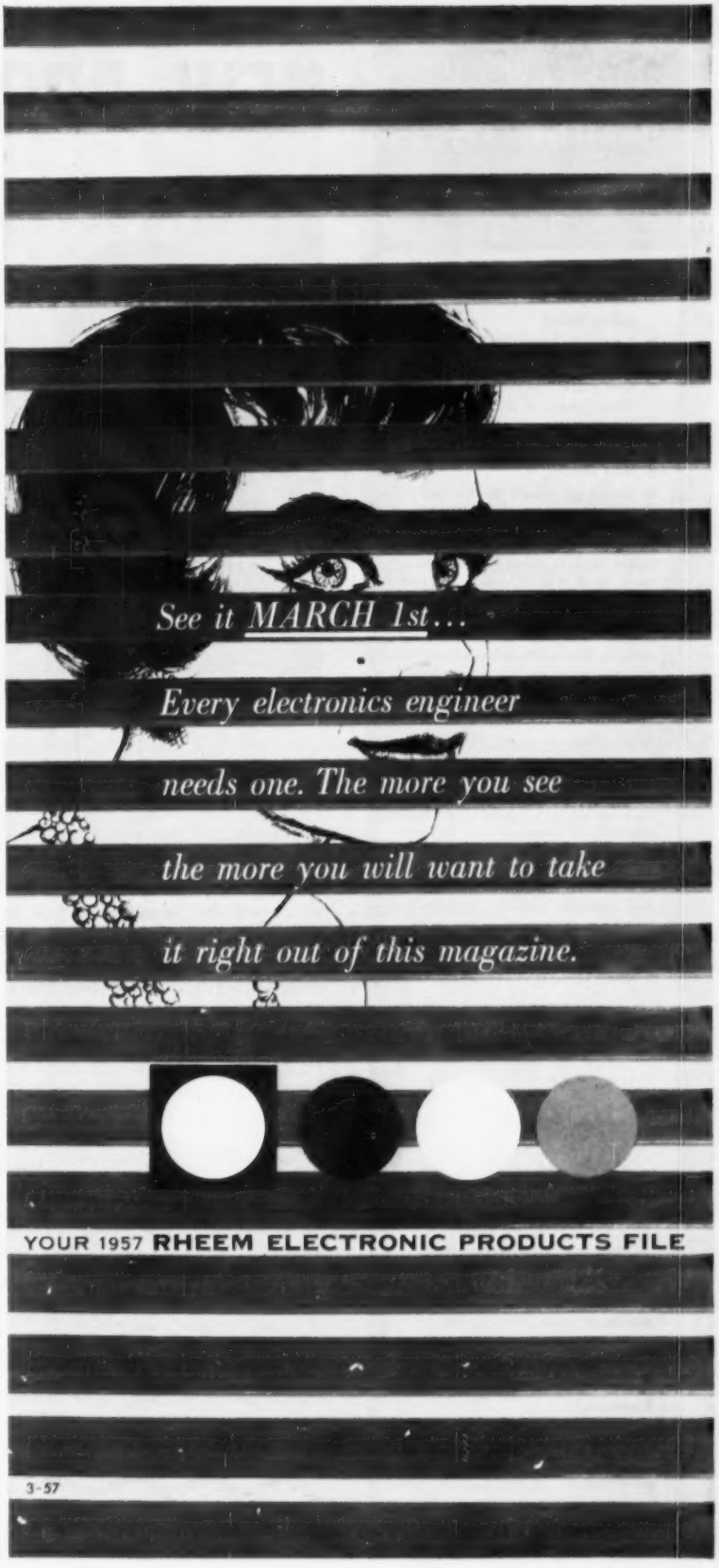
Link Aviation has received a $2,100,000 AMC contract for F-106A flight simulator trainers, (Type MB-42), spare parts, special tools and engineering data.

Ogden Air Materiel Area, Hill AFB, Utah, has contracted Link Aviation for Modifications amounting to $3,180,000 of F-89D flight simulators (Type S-14).

Westinghouse has received a $529,000 contract, including construction and equipment costs, from ARDC's Rome Air Development Center for experiments with over-the-horizon scatter propagation. The program which began two years ago, is designed to provide answers to long distance uhf transmission problems.

The experiment consists of two communications stations—a receiver station near Baltimore and a transmitter installation 285 miles away in Verona, N. Y.

Minneapolis-Honeywell has undertaken a half-million dollar study contract with ARDC for design work, mock-ups and wind-tunnel models of a new air-to-ground rocket.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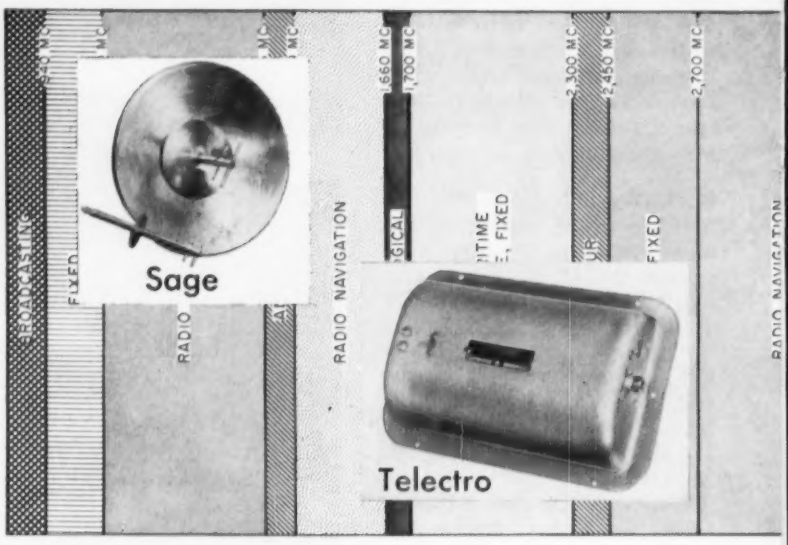


COMPONENTS such as these are helping designers of radar, telemetering

DESIGN ENGINEERS working on radar, countermeasures, telemetering and microwave communications systems have available a variety of new components. An antenna designed by **Sage** (P1) combines a dipole and a parabolic dish to operate at 1,000 to 1,350 mc and 2,750 to 3,000 mc or other pairs of specified frequency bands. A 75-mc antenna developed by **Telectro** (P2) is intended for use with aircraft marker-beacon receivers.

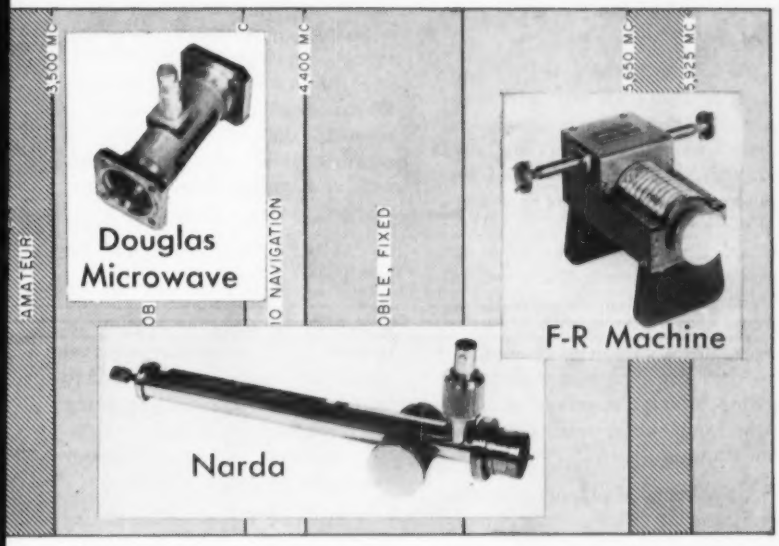
Douglas Microwave's (P3) broadband coupler is said to have a minimum directivity of 23 db in the frequency range from 100 to 3,000 mc. An r-f probe by **Narda** (P4), for use with all waveguide and coaxial slotted lines having ¾-inch mounting holes, is tunable from 900 to 18,000 mc. Attenuation readings over the frequency range of 50,000 to 75,000 mc are provided by **F-R Machine's** (P5) variable attenuator.

Kahle (P6) has developed cathode-ray tube sealing machines which are said to handle unusual shapes including neck lengths up to 40 inches. . . . A complete line of 60 and 400-cycle servo amplifiers offered by **Industrial Control** (P7) is designed for use with all widely used servo motors. . . . **Amphenol** (P8) announces two coaxial cables for high-temperature applications which feature nonmagnetic conductors.

A line of ultrasonic generators designed by **Gulton** (P9) furnishes 500-watt r-f output at a variety of frequencies for operating ultrasonic transducers in cleaning, chemical processing and soldering operations. . . . **Tektronix'** (P10) type 126 power supply has been designed specifically to operate their indicators or waveform generators. . . . Printed-circuit terminals are available on **Phillips Control's** (P11) type 8 relays.

For more information circle numbers in SECTION B, READER SERVICE CARD (facing p 48)

r-f designers



and navigation equipment to do more things and to do them better

Vidaire's (P12) high-pass filter cuts off frequencies below 50 mc to reduce interference in tv intermediate-frequency bands. . . . A 14-inch closed-circuit tv monitor by **Kay Lab** (P13) is claimed to require no line amplifiers when connected to the camera control unit by a single coaxial cable up to 1,000 feet long. . . . **Birtcher's** (P14) retainers for holding tubes and components in place during severe shock and vibration are easily removed for servicing equipment.

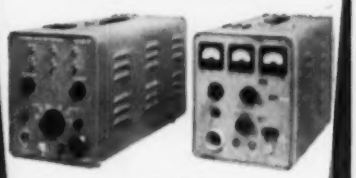
A d-c power supply with steady-state regulation accuracy of 0.01 percent has been announced by **Perkins Engineering** (P15) for computer applications. . . . **Panoramic Radio's** (P16) sonic analyzer is claimed to provide a rapid graphic presentation or permanent record of the performance of jet and reciprocating engines, business machines and pumps by converting sound vibrations to electrical waveforms. . . . Combined push-pull switches and printed-circuit type volume controls are available from **Mallory** (P17).

Transitron's (P18) sweep generator incorporates a standard signal generator and oscilloscope for measuring sensitivity, selectivity and image rejection of vhf and uhf receivers. . . . A rotary test head announced by **Millitest** (P19) permits indexing of the shaft position of potentiometers, resolvers and synchros. . . . Solenoids are available from **Menlo Park Engineering** (P20) which have been designed to supply the magnetic focusing field for traveling-wave tubes.

Micro Gee's (P21) turntable for testing rate gyros can operate in temperatures between −67 and 187 F. . . Data repeaters made by **Feedback Controls** (P22) for use in aircraft instrumentation can furnish remote indication of shaft position and a-c and d-c voltages. . . . A power supply furnishing a continuously variable output from zero to 50 volts has been designed by **Dressen-Barnes** (P23) for transistor applications.

Allen-Bradley (P24) announces a flared ferrite deflection-yoke core for 110-degree picture tubes which is claimed to weigh 30 percent less than conventional cylindrical cores. . . . Thermal relays by **Networks Electronics** (P25) for computer

High Power* Oscillator



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Specifications

Frequency Range:
200 to 2500 mc (in two bands, 200-1050 and 950-2500 mc/sec) Coverage to 3000 mc/s upon special request.

***Power Output:**
200- 400 mc—at least 40 WATTS
400-1050 mc—at least 25 WATTS
1000-2500 mc—at least 10 WATTS
(Power output variable by front panel control.)

Calibration Accuracy:
±1% or ±5 mc, whichever is greater

Resettability: < 0.1%

Output Impedance:
50 ohms (nominal)

Modulation:
1. External; 2. Internal square-wave, 400 & 1000 cps; 3. Internal sine-wave, 400 & 1000 cps; 4. CW

Power Requirement:
115V a-c, 50/60 cps, single-phase, 375-watt

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By John MARKUS and Vin ZELUFF
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352 pages, 412 diagrams, $8.75

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and telemetering applications are claimed to withstand extreme environmental conditions. . . . A d'Arsonval torque motor has been developed by **Westinghouse** (P26) for use in miniature gyroscopes used in fire-control systems.

Fischer & Porter's (P27) transient converter for use with turbine-type flow meters accepts an input varying in frequency and produces either an analog output for oscilloscopes or recorders or a digital output for counters. . . . A 110-degree 17-inch tv picture tube announced by **Sylvania** (P28) weighs 3 pounds less than its comparable 90-degree tube. . . . **Tensor** (P29) introduces automatic sampling switches which permit sequential testing of large numbers of electronic components under operating conditions.

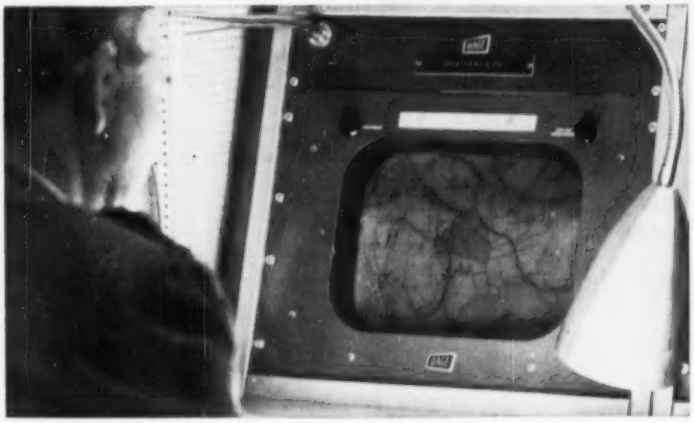
A line-operated pH meter offered by **Photovolt** (P30) costs less than $100. . . . Designed to operate on either 6- or 12-volt batteries or 117-volt a-c power, a mobile radio made by **Sands Associates** (P31) for railroad applications has an 8-kc bandwidth. . . . A limiter amplifier designed by **Electronic Systems** (P32) for transmitter modulation control features a squelching system for limiting audio frequencies.

Hermes Plastics (P33) announces a metallic engraving stock for panels where grounding or shielding effects are required. . . . A rate gyro produced by **Humphry** (P34) for missile applications is claimed to withstand severe shock and vibration. . . . **Beckman Instruments** (P35) is manufacturing a transformation ratio meter designed to provide a direct indication in percent deviation of transformation ratio of a synchro from ideal ratio.

Portable x-ray equipment made by **Andrex** (P36) is suitable for periodic inspection of aircraft door frames for cracks and corrosion and a recheck of previous welding repairs. . . . A screwdriver actuated switch is available from **Micro Switch** (P37) which eliminates the space required for a knob and can be mounted in out-of-the-way places on electronic chassis.

A machine for vibration testing has been produced by **Ahrendt Instruments** (P38) and features continuously variable control of amplitude and frequency. . . . **Advance Electronics'** (P39) delay network can provide delays up to 1,000 microseconds for testing of precision triggering systems and computers. . . . **Fischer Scientific** (P40) has developed a transistor relay unit

TV briefs flyers on WEATHER



ARMED Forces use Dage closed-circuit tv to report weather conditions at Grandview Air Force Base, Mo. Pilots in squadron briefing rooms see maps instead of listening to descriptions

for applications such as control of temperature where only a small amount of power is available.

A printed-circuit type volume control, designed by **Mallory** (P41) for use in transistor circuits features a gradual resistance rise from zero over the first 20 to 30 degrees of rotation. . . . **Haydon's** (P42) elapsed-time indicators for recording running time of electronic apparatus have low power consumption so that they can be located at some distance from the equipment. . . . **Allen-Bradley** (P43) announces a line of 5-watt low-noise variable resistors for such industrial applications as magnetic-amplifier motor-control circuits.

Anchor Plastics (P44) is producing nylon extension shafts with flattened ends which are claimed to eliminate the need for knobs. . . . A portable echo-free chamber designed by **Eckel** (P45) is expected to facilitate study of the acoustical behavior of radio, tv and audio equipment. . . . **Good Electronics'** (P46) 50-channel selector switch has been designed for strain gages, thermocouples, transducers and multichannel testing.

Continuously variable outputs from zero to 32 volts at up to 10 amperes are available from **Universal Electronics'** (P47) magnetic-amplifier power supply. . . . A line of accelerometers announced by **Gulton** (P48) for measuring varying environmental data up to 40 cps covers the amplitude range from 1 to 10 g. . . . Dual concentric-shaft precision potentiometers available from **Waters** (P49) have standard ¼- and ¼-inch shafts controlled by a dual knob.

A seven-cell selenium rectifier announced by **Federal Telephone and Radio** (P50) is constructed so that the cells are placed flat against each other with no center shaft required. . . . **Weston's** (P51) two-pen recording instrument has two independent amplifiers so that comparative recordings can be made in the laboratory or on the production line. . . . Precision wire-wound resistor networks have been released by **Eastern Precision Resistor** (P52) which fit the front

Kearfott Servo Motor-Generators are characterized by low rotor inertia, low time constants and high stall torque. Motor-Generator combinations provide ½ to 3.1 volts per 1000 R.P.M. with an extremely linear output over a speed range of 0—3600 R.P.M. and useful output up to 10,000 R.P.M.

**New Size 11 low cost, Servo Motor-Damping Generator Type R 809.*

CHARACTERISTICS

TYPE	MOTOR		GENERATOR	
DAMPING	STALL TORQUE	NO LOAD SPEED	OUTPUT FUND. NULL	LINEARITY
SIZE 10	.35 OZ. IN.	6000	21/1	.5%
SIZE 10	.30 OZ. IN.	8500	23/1	.5%
NEW R 809	.63 OZ. IN.	5900	25/1	.5%
SIZE 15	1.5 OZ. IN.	5000	25/1	.5%
SIZE 18	2.4 OZ. IN.	5000	25/1	.5%
SIZE 18	3.0 OZ. IN.	9600	23/1	.5%
RATE				
SIZE 15	.45 OZ. IN.	10,500	170/1	.5%
SIZE 15	1.5 OZ. IN.	4700	350/1	.2%
SIZE 18	2.4 OZ. IN.	4700	350/1	.2%
SIZE 18	3.0 OZ. IN.	8400	350/1	.2%
*INTEGRATOR				
SIZE 15	.70 OZ. IN.	6300	400/1	.1%
SIZE 15	1.25 OZ. IN.	4500	400/1	.1%
SIZE 18	1.35 OZ. IN.	7200	400/1	.1%
SIZE 18	2.4 OZ. IN.	5200	333/1	.06%
SIZE 18	3.0 OZ. IN.	8000	333/1	.06%

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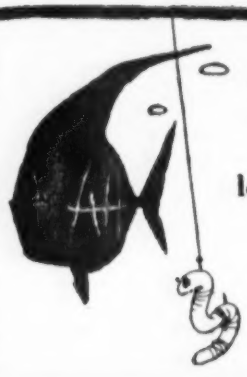

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panel of strain-gage amplifiers.

Photosensitized copper-clad sheets, available from **Keil Engineering** (P53), are said to make possible on-the-premises production of etched-circuit panels. . . . Toggle switches available from **Carling Electric** (P54) feature colored plastic toggles for color coding of electronic panels. . . . **Franklin Electronics'** (P55) pulse generator, for calibrating nuclear instruments such as linear amplifiers and radiation spectrometers, is said to be stable within 0.02 percent per day.

Amperex's (P56) twin tetrode, type 6907, designed as a class C amplifier for mobile and airborne communications equipment, delivers 25 watts at 462 mc. . . . Subminiature potentiometers available **from Ace Electronics** (P57) are claimed to be linear within 0.1 percent. . . . **Weldex** (P58) announces 5- and 10-kva bench-type welders designed for light nonferrous metals such as are used in electron-tube manufacture.

A 9-pin miniature socket announced by **Sylvania** (P59) for portable tv applications offers protection against corona. . . . **Industrial Gauges'** (P60) high-speed electronic inspector has been designed to check internal and external sizes of machined parts. . . . Four simultaneous regulated bias voltages are available for substitution in color and black and white tv alignment with **Precision's** (P61) multibias supply.

Borg Equipment's (P62) single-turn linear precision potentiometers are said to meet all military environmental requirements. . . . A line of basic meters offered by **WacLine** (P63) offers high sensitivity, high torque-to-weight ratio and meets the requirements of MIL-M-6A and MIL-M-10304A. . . . **Macdonald's** (P64) sleeving cutter can produce up to 10,000 pieces per hour and is said to cut glass fibers and silicone-coated nylon tubing without crushing.

Size 10 servo motors designed by **Avionics** (P65) for use with transistor amplifiers are said to be less subject to single phasing.

Want a TALL tv tower?

Airspace Panel approvals run high
Compromise is working method
JIGTSC works on firmer rules

How HIGH IS TOO HIGH for a tv antenna tower? The answer is, "It depends."

By the end of 1955 there were some 25 tv towers over 1,000 feet. There are at the moment 43. One estimate for 1957: 20 more.

There is a compelling reason for as much height as can be attained. The higher the tower, the more people reached by the tv signal. The more people reached, the more money the station can make.

Towers less than 500 feet are acceptable by the FCC. Not automatically, however, if they are near airports or on a mountain peak where they claw into an airway corridor.

For any tower over 500 feet the FCC asks the advice of the Airspace Panel in Washington.

The Airspace Panel is aviation's attempt to allocate space for everything that sticks up tall or flys in the air. Its board is composed of Army, Navy, Air Force and Commerce Department representatives.

Some 5,000 towers over 500 feet tall have formally been considered by Airspace Panel since 1950 for an opinion. It rejected only a handful.

Compromise has been the reason for the good record. The Panel has been obliging. It has moved airways and raised minimum altitudes for planes rather than object.

Tv stations have also been tractable. Most have gone informally to aeronautical authorities near home for opinions before asking for construction permits.

Airspace subpanels, eight of them across the country, have aided stations. They have worked out acceptable compromises on tower sites and heights.

Three split opinions on towers have been sent to the FCC by the Airspace Panel. In each case the Commerce Department approved while the services, all three, voted nay.

In two of the cases, KSWS-TV, Roswell, N. M., and KGEO-TV, Enid, Oklahoma, were given the go ahead by the FCC. KSWS-TV will have the tallest tower in the nation. 1,610 feet from the ground, it will be 6,086 feet above sea level.

Final FCC approval for the third split decision is still in the future. WSLA-TV, Selma, Alabama, wants a 1,993 foot tower.

Industry boosts TAPE sales

MAGNETIC TAPE MARKET, which grossed $12 million in 1956, may reach $20 million this year. Conservative estimates figure on at least a 25-percent increase in tape consumption. One enthusiastic manufacturer expects industrial demand for pulse-recording tape to push this year's gross above $25 million.

One future market is just now opening up: Tv tape.

Video recording will make only a ripple in 1957's consumption of magnetic tape, says 3M. Industrial uses now consume 10-15 percent of the magnetic tape produced. This area is expected to show the greatest growth as more tape-fed computing systems and data-recorders hit the market. Ultimately, industrial uses may account for half the market.

FCC actions

Educational tv channels are becoming available for commercial allocation. Release of channel 5 in Weston, W. Va. marks the second time the Commission has unreserved a vhf channel. In the previous case a uhf channel was substituted.

Hearings on the reinvestigation of allocations of frequencies in the bands above 890 mc are set for April 1.

AT&T gets authority until June to conduct two-way radiotelephone tests with RCA Communications at Tangier, Morocco. This is to determine the feasibility of establishing a direct circuit for radiotelephone service between the U. S. and Morocco.

Jackson, La., loses channel 18 to Baton Rouge, La. and gains channel 59.

Great Western Radio Co. was granted a construction permit for a-m station in Midland, Texas.

KBTX-TV, Bryan, Texas, plans to be on the air in a couple of months. Channel 3 was originally assigned as an educational outlet, but the Brazos Broadcasting Co. finally got the FCC nod.

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Operating from standard 115v 60 cps power, the Model 1460 provides 400 cps 100-130 volt supply at any bench position. Utilization of units of this type allows testing at 400 cps - 10% at any individual position without interference with any other test position. The unit can be easily operated by unskilled personnel.

Catalog "M" describing this unit as well as other CML generators in the power range of from 50 VA to 80 KVA in single and three phase units and frequency range of 20 cps to 60 KC with all specifications listed, is yours on request.
Our design engineering department is at your service to design and custom-build a power supply unit for your specific need.

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STABILITY - 1 CPS
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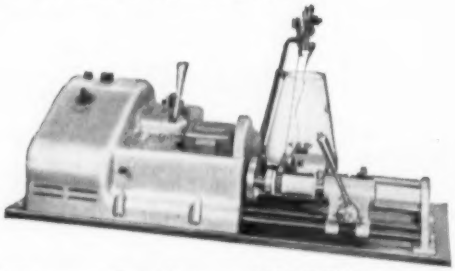
***Gearless* BOBBIN WINDER**
Adjustable Winding Length

Gears eliminated by new pitch selector; no gear changing between jobs required. Merely set selector lever at desired pitch and wind all types of random wound bobbin coils, solenoids, repeater and relay coils up to 2" OD using 27 to 46 gauge wire.



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Save time, increase production, lower costs with Model 312-AM.

GEO. STEVENS MANUFACTURING CO., INC.
Pulaski Rd. at Peterson, Chicago 30, Ill.
The most complete line of coil winding equipment made

STATION moves and plans

F-M network of fine music stations was formed on the West Coast. Stations KISW, Seattle, Wash.; KPFM, Portland, Ore.; KNEV, Reno, Nevada and KEAR, San Francisco are the first to participate.

WBBR, Brooklyn, N. Y., was sold by the Watchtower Bible and Tract Society to Tele-Broadcasters for $133,000. Telebroadcasters already owns five stations.

WEBK, Tampa, Fla., was bought for $134,000 from Hillsboro Broadcasting by W. Walter Tison.

Ohio University was granted a construction permit for a-m educational station in Athens, Ohio.

Macon County Broadcasting Co. was granted a construction permit for a-m station in Franklin, N. C. Owners are Graves Taylor, Henry G. Bartol Jr. and John E. Boyd.

KGVO-TV, along with a move to new quarters in downtown Missoula, Mont., changed its call letters to KMSO-TV.

KYME, Boise, Idaho, is now controlled by Roger L. Hagadone. He purchased the necessary stock from Richard K. and Virginia L. Mooney.

KEX, Portland, Ore., the last Westinghouse Broadcasting radio outlet to have a network affiliation, has gone independent. Formerly tied to the ABC network, it follows the path of the four Westinghouse stations which broke off from NBC last summer.

WWRL-FM, New York, N. Y., after three years as a noncommercial station, began accepting commercials. Along with its move, it increased program time by nine hours a day.

ASSEMBLY lines for AiResearch's angle-of-attack computer hum bringing . . .

New life to PHOENIX

Federal dispersal uproots plants
Southwest sun draws them
Labor pool, taxes are also trumps

MANUFACTURERS are moving to Arizona. Pushed by the government's dispersal program, and pulled by the lure of lush, uncropped labor pastures, they have begun to trek inland. Since March, 1948, over 200 manufacturers—many in electronics—have located plants or branches in the state capital at Phoenix.

Garrett's AiResearch was the first major firm to take the long, dry leap into Phoenix. Within the last two years, they have been followed by Motorola's semiconductor plant, Sperry Rand's new Sperry Phoenix division, GE's computer department and Goodyear Aircraft's electronic research department. New plants start at a current rate of four a month.

Emigrants readily trot out their reasons. The principal one is the climate. The air is clear, dry, sunny (313 days of sunshine yearly, mean temperature 69.4 degrees). Flying weather for flight-testing is no problem. Electronics manufacture and assembly are simpler, with fewer problems of humidity and temperature control.

The climate attracts 25,000 people to Phoenix every year. There is a labor surplus despite burgeoning industry. In Tucson, Hughes Aircraft plant manager William Wooldridge says flatly, "We have no labor procurement problems." His turnover is 1.6 percent, less than half the national average.

The tax climate in Arizona encourages industrial growth. There is no tax on manufacturers' inventories, Federal sales or goods warehoused for delivery outside the state.

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MEMORIES search faster

Large random-access types appear
Parallel operations performed simultaneously
Other new systems gain wide acceptance

WINTER MEETINGS of the professional societies, and big electronics-in-business shows, are being used to introduce new computer memories to the business community. Computermakers are evolving new concepts of information retrieval. Parallel searching is one of the keys.

Computers now on the market can record data fast enough for most business problems. The tougher nut to crack is how to find one piece of information among millions, and find it quickly.

Eastman Kodak, developer of the Minicard coded-microfilm memory system, is helping Bureau of Standards work out the bugs in a machine called Fosdic. New Fosdic system photographs the Weather Bureau's punched cards, uses a flying-spot scanner to search and select related data. It can record its output on magnetic tape or punch it into cards.

Burroughs is now producing the Datafile, which stores up to 20 million characters on fifty free loops of magnetic tape. The machine, about the size of a deepfreeze, takes an average of 14 seconds to find a 200-character block. Units rent for $825, sell for $25,000.

IBM produces a magnetic "jukebox" memory. The disk storage unit, called Ramac, can hold up to 5 million characters, which are accessible in under a second.

Remington Rand's principal entry in the data-retrieval field is the Univac File-Computer. This magnetic-drum system can store 1.8 million characters, gain access to any character in less than $\frac{1}{10}$ of a second. File Computer rents for upwards of $2,500 monthly.

Underwood does not yet build a parallel-search memory, prefers instead to separate computing and file-processing functions in their Elecom 125.

Potter Instrument's Ram stores digital information on "pages" of magnetic material.

Kids want electronic TOYS

BUILD-IT-YOURSELF radio uses one transistor, one diode

ELECTRONIC toys worth over $5 million were sold last year. They were only a tiny part of the total toy market. But toy industry sources say the figure could climb rapidly due to the romantic appeal electronics has for youngsters.

Remco Industries hit the jackpot in 1956 with transistor radio kits selling at $7 and $10. Each contained one Tung-Sol or Clevite transistor. A Remco spokesman said that over 500,000 kits were sold and the company plans to make them again in 1957.

All evidence points to increased sales of electronic toys, according to Toy Guidance council officials. The Toy Information bureau of the Toy Manufacturers of U. S. A. reports a heavy demand at retail outlets.

If prices can be dropped, Irving Levy, general manager of Keneddy Brothers, toy distributors, says, electronic toys will sell big. The only serious drawback has been the difficulty manufacturers have in keeping prices within the mass toy range.

A case in point is a Japanese radio-controlled bus. Levy's firm and others sold 50,000 in the U. S. after the price was dropped from $25 to $13. A U. S. firm tried to market a radio-controlled car at $65 and failed. A German radio-controlled bulldozer was a flop at $40.

The Japanese bus is operated by a six-pulse radio system incorporating a spark transmitter and carbon crystal receiver.

PHONO sales press $½-billion

THERE IS A happy war going on in the phonograph industry between the mass-producers and the custom component makers. They clash on the definition of "high fidelity". But production on both sides is climbing.

High fidelity labels are put on some phonographs selling for under $50. Prices, however, generally start at $100. The hobbyist assembling a hi-fi system from custom components currently begins at about $200 but will probably eventually invest $500.

Estimates of the phonograph mass market range to $500 million annually. RETMA says sales jumped from 489,000 sets in 1953 to 2,223,695 in 1955. The previous high was in ante-tv 1946, about 917,000 sets. Custom market estimates go to $80 million. A leading supplier says sales are $35 million and gaining 12 to 15 per cent a year.

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30	40	9,000	15,000	20,000
50	75	4,800	8,000	10,000
100	125	2,000	3,500	5,000
150	175	1,500	2,500	3,500
200	250	1,000	1,500	2,500
250	300	800	1,250	1,750
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FRANCE aims at $500 million

Electronics sets 1961 sights high
Exports valued at $77 million seen
Imports to be reduced drastically

France's electronics industry has big ideas about its future role in the nation's economy.

The industry has set extremely optimistic goals for itself as part of France's new five-year economic modernization plan.

Industry leaders expect to double their 1954 gross sales and quadruple their 1954 exports in the next five years. That would mean gross sales of $502 million and exports valued at $77 million by 1961.

At the same time, the French expect that electronics imports will be reduced drastically.

A planning commission set up last year took 1954 as the base year and called for an overall industrial 45 percent increase in production by 1961.

In setting its own goal much higher, the electronics industry is out to prove that it will have the greatest proportional expansion of all French industries in the next five years.

The French electronics industry consists of more than 2,000 companies, most of them small and grouped around Paris. Only 10 companies employ more than 1,000 people and 10 others more than 500. Only 22 companies grossed more than $3 million during 1955.

Best customer is the French government, for the country's defense program and communications. In addition, the electronics industry, like other French industries, receives an export subsidy in the form of a tax rebate on goods sold abroad.

This subsidy has been necessary to the industry to develop markets. French electronics equipment often costs 30 to 35 percent more than that of other countries. It is precision-made. Part of the price difference is made up by the government rebate.

Through licensing agreements and technical assistance programs the French are also exporting materials and techniques.

Developments ABROAD

Portuguese postal authorities have signed a $5,500,000 contract with Standard Telephones and Cables of London for a 210-mile telephone link between Lisbon and Oporto that will carry 3,000 calls simultaneously by the end of 1958. Installation will be done by Standard Electrica. Both companies are IT&T affiliates.

Decca Radar Ltd., London, announces a new marine radar system said to give an accurate bird's-eye view of all shipping in the surrounding area. The company says both stationary and moving objects are shown on the cathode-ray tube beyond possibility of mistake.

Oxford University is now using a new $210,000 Mercury computer that does 3,000 multiplications and 5,100 additions in one second—without hitting top speed. The computer will solve calculations relating to atom physics, vitamin research and language studies. Oxford may provide computer training for summer school students.

Marconi's Wireless Telegraph Co. is offering a new range of vhf radio transmitters and receivers that use forward scatter from the ionosphere to transmit radio beams for a thousand miles. The company says the system is highly reliable day or night and is unaffected by magnetic disturbances. Transmitters and receivers operate in the 33 to 55-mc band. The transmitters have a power output of 20 kw.

Italy, where television was introduced in 1953, now has 31 tv stations. Even the island of Sardinia has been brought into the Italian tv system.

The number of sets in Italy rose from 178,793 at the end of 1955 to 287,468 by June 1956. Manufacturers hope sales will rise in two or three years to a half million sets a year. A 17-in. set installed is priced from $150 to $200, a reduction of 100 percent over two years ago.

Pye of England has developed an all-purpose underwater tv camera capable of operating at a depth of 3,000 feet. The camera has a single wide-aperture lens with remote focusing and motorized aperture control. It incorporates an image-orthicon camera tube.

English beekeepers now have something electronic in their bonnets. Wayne Kerr Laboratories Ltd. has devised a microphone-amplifier-analyzer system which triggers a signal before a hive of bees is about to swarm. The hum of the bees changes frequency a half hour before swarming, something an experienced beekeeper can tell only if he's right on the spot.

EXPORTS and IMPORTS

In Stockholm a live tv presentation was used at Sweden's annual business equipment show to demonstrate the Alwac computer solving problems and processing data. Viewers were able to talk with the computer operators at a computing center elsewhere in Stockholm. The electronic data processing system is manufactured by Logistics Research, Redondo Beach, Calif.

Italy's Stacchini Co., has received a contract from the Japanese government for 500 Airone type air-to-air guided missiles which, within a range of 55 yards from the target, are automatically guided to it by electronic controls.

In South Africa Mullard of London is expanding facilities of its subsidiary, Mullard South Africa, to meet demand for the development of a domestic electronics industry that will be able to meet growing requirements.

In India, Philips of the Netherlands will open a new plant in Poona, southwest of Bombay, to manufacture loudspeakers, paper and ceramic capacitors, potentiometers and transformers.

France's Simca automaker, has contracted for an electronically controlled automatic conveyor for a car-body painting plant. Contract went to George W. King Ltd. of England. The electronic controls are being designed and manufactured by Electrical & Musical Industries Ltd. Cost of the installation at Simca's Poissy factory is estimated at about $1.5 million.

Lenkurt Electric has formed an international subsidiary, Lenkurt International, which will have its main office in Panama City. The new subsidiary will handle sales of carrier and microwave radio communications systems to distributors as well as direct sales from Lenkurt factories in U. S., Canada and Mexico.

Snake in the grass!

Wide Area Infrared Detection System Unerringly Seeks Out Target

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PLANTS and PEOPLE

AUTOMATIC device burns ribbon at dedication of Consolidated Electrodynamics research center. Watching: president Philip Fogg

NSF head sees brainpower short

THE SHORTAGE of scientists, and the imbalance between applied and basic research, are serious threats to technological progress, according to Alan T. Waterman, director of the National Science Foundation.

Speaking to more than 2,000 persons at the dedication of Consolidated Electrodynamics' $1.5-million research center in Pasadena, California, Waterman pointed out that only four percent of all industrial research and development money goes to basic research. In the universities, shortages of both teachers and funds affect basic research programs. These conditions, the NSF chief said, "warn us that unless appropriate adjustments are quickly made, scientific research and development as a whole may suffer."

Waterman remarked that the responsibility for correcting the situation is one "in which all of us—the government, private industry and the community at large—have an equal share." He warned that our national well-being depends on the extent to which the community at large and private industry in particular, understand and attack the problem.

Officials of Consolidated Electrodynamics and of the city of Pasadena also spoke at the dedication of the 130,000-sq ft lab.

IBM builds San Jose computer plant

FIRST 200,000-sq ft building of IBM's new data-processing plant facility in San Jose, California, is now occupied. One of four manufacturing buildings planned for the 150-acre development, it houses production facilities for the magnetic-disk Ramac computer.

Before year's end, the development will have expanded to 968,000 sq ft, will include a total of ten buildings. Work is already in progress on engineering facilities and two of the three manufacturing buildings. An engineering lab and a research building, of 40,000 sq ft each, will be completed by April 1. The multimillion dollar installation will be the largest electronics factory in the San Francisco bay area.

Besides the four manufacturing plants, the completed facility will comprise four engineering and research laboratories, a cafeteria-lounge building and a five-story administration building. About 5,000 people will be employed there.

New SPERRY deal

HARRY Vickers' sprawling Sperry Rand Corp. continues to settle into shape. Sperry Gyroscope now has some new officers, resulting from the retirement of president Charles M. Green. Carl G. Holschuh moved up from the job of executive v-p and general manager to become president. Carl A. Frische, former vice president for operations, stepped into Holschuh's shoes.

Remington Rand Univac division undergoes another realignment as Rem Rand vice president Al N. Seares takes control of management services and operations research. The sales managerships of the three computer product lines are now stabilized on a single level: Carl J. Knorr for the various Univac Scientifics, George K. Campbell for the File-Computer and

Executive MEETINGS

Feb. 15-16: Cleveland Electronics Conference, Masonic Auditorium, Cleveland.

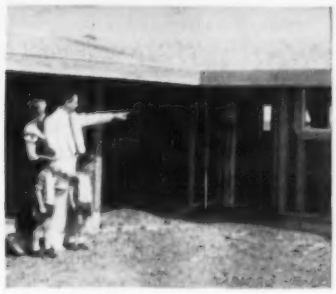
Feb. 25-27: AMA Electronics Conference and Exhibit, Hotel Statler, N. Y.

March 11-15: 1957 Nuclear Congress, Bellevue-Stratford Hotel and Convention Hall, Philadelphia. AIEE and IRE among sponsors. Papers March 13 and 14 on reactor instrumentation and control, simulators, instruments.

March 18-21: IRE National Conference and Exhibit, Waldorf-Astoria and Coliseum, New York. Also First Military Automation Exposition, N. Y. Trade Show Building.

punched-card machines and James A. Finigan for the big commercial Univac.

Thornton C. Fry, mathematician who was once assistant to the president of Bell Laboratories, has been recalled from retirement to serve as senior consultant to all the subdivisions of the Univac division.



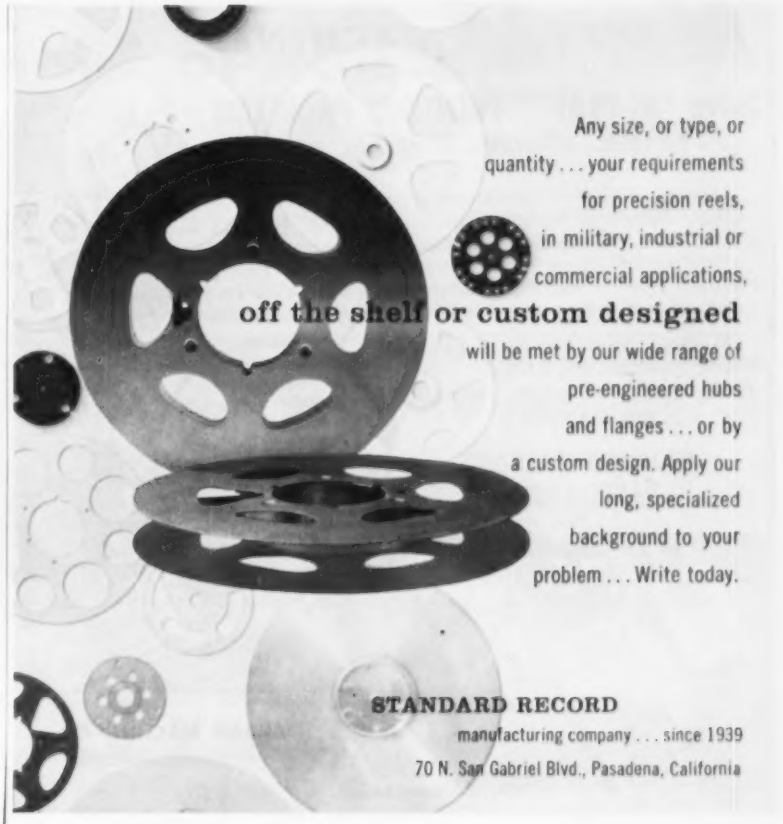
ENGINEER Paul Engard and family inspect new home as . . .

BECKMAN moves plant, 1,200 people

PASADENA potentiometer-maker Beckman-Helipot, in moving the 60 miles from the San Gabriel valley to the coastal region below Los Angeles, is taking 70 percent of its staff along. The mass exodus of some 1,200 people—all of the supervisory employees, 85 percent of the key manufacturing lead people and half the production workers—cost Helipot a quarter of a million dollars.

The movement of the production facilities is taking place in two stages. From 14 scattered spots in Pasadena and nearby Alhambra, Helipot moved into 17 temporary locations in the town of Costa Mesa. These will be consolidated in a $3-million plant in Newport Beach, to be completed by May. In the meantime, the uprooted employees are settling into new in and around Newport Beach, a community 40 miles down the coast from Los Angeles.

Helipot paid 75 percent of the personal moving expenses of the employees. Staffers were encouraged to move with the company, and were helped with advice on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Plant BRIEFS

Acme Electric, Cuba, N. Y., manufacturer of transformers and d-c power supplies, is adding 23,000 sq ft to its present plant capacity. The addition, costing $175,000, will accommodate 200 more employees, permit Acme to diversify its product line.

Philadelphia instrument maker **Nuclear-Electronics Corp.** is building 8,000 sq ft of new production plant.

Budd Company subsidiary **Tatnall Measuring Systems** is moving into a new location in Phoenixville, Pa. The 22,000-sq ft plant, set on a 10-acre site, will be used for the development and production of industrial measuring systems.

Executive MOVES

Stromberg-Carlson has moved four of its executives up a notch. **Sidney R. Curtis,** v-p in charge of government contracts and head of the electronics division, becomes senior vice president of Stromberg-Carlson. Former manufacturing v-p **George A. Peck** takes over the general managership of the electronics division. Industrial relations director **George E. Eyer** moves up to the job of vice president for properties and his former assistant, **Austin C. Tait,** moves into Eyer's old job.

Oliver C. Haywood, who directed research on the Manhattan project, moves from the job of managing Sylvania's Waltham laboratories to become manager of the Electronics and Avionics division of Emerson Electric.

Harry O. Reichelderfer, for over seven years one of the Signal Corps' top brains is now an assistant v-p in the Physical Sciences division of Southwest Research Institute, San Antonio. Reichelderfer, a retired major-general, will serve as liaison between the Institute and some of its military and industrial sponsors.

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REPS merging for more sales

To KEEP UP with headlong industrial expansion, some manufacturers' representatives find it helpful to follow the merger trail. Joint rep ventures combine diverse experience.

Just-married ventures include **Bush & Wharfield,** which will cover the Rockies. Salt Lake City rep **Leon S. Bush** joins former Allied Radio distributor **Chet Wharfield** of Denver. The principals will work out of their home cities.

Rep **Robert L. Ringer Jr.** joins with former Measurements Corp. sales v-p **G. R. Mezger** in the new firm of **Ringer-Mezger,** Glen Rock, N. J. The organization will serve the New York-Philadelphia areas.

Los Angeles instrument-maker, the Arnoux Corp., now has outlets in Philadelphia and the Dayton Cleveland area. **Fred F. Bartlett** has the Philadelphia appointment, while Ohio, Kentucky and Indiana will be covered by the **Bernard L. Michaelson Co.**

Fred A. Pease, Denver, and **Tex-O-Koma Sales,** Grand Prairie, Texas, are new reps for the precision potentiometers of the Gamewell Co., Newton, Mass. Rep Pease also accepted the handling of International Electronic Research's line of tube shields. Pease is one of the growing number of reps who covers his territory by airplane. Another Gamewell rep, **Electro Sales,** has opened an office in Dayton with facilities for handling classified government negotiations.

LA distributors grow

LOS ANGELES distributor **V & H Radio** has expanded into a 12,000-sq ft showroom, first step in a three-year expansion program.

K & L Radio Parts is forming a new division to distribute telemetering and computing supplies in Los Angeles, southern California and Arizona.

North Hollywood's **Arrow Sales** organization will build a 30,000-sq ft warehouse and sales office, aims to assemble the largest inventory of electronic and airframe parts in the West.

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About our TECHNICAL edition . . .

An audible signal provided by a device whose frequency is dependent on light intensity may help the blind to perform such tasks as reading meters. C. R. Hurtig tells in the Feb. 1, edition of ELECTRONICS how the substitution of transistors decreased weight in a redesigned model by making possible the use of a 1.5-volt cell instead of a 90-volt battery.

Welding of fine wire and metal foil can be done with a precision resistance spotwelder described by W. W. Robinson of Pacific Welding in our Feb. 1, edition. By adjusting the level of voltage stored in a capacitor bank, the amount of heat generated by each pulse can be controlled.

A stable frequency generator for controlling frequency in single-sideband transmitters and receiver local oscillators is explained in our Feb. 1, edition by M. I. Jacobs of Westinghouse. A beam-switching tube with ten plates is used as a frequency divider to enable the output of the ssb generator to be changed in 1-kc steps over range of 2 to 30 mc.

Part of the work on IGY involves detection and analysis of disturbances occurring in the ionosphere during solar flares. A detection system is described by R. H. Lee of the High Altitude Observatory at Boulder, Colo. in our March 1, edition. It uses two radios, one at 27 kc and the other at 18 mc.

Acoustic system of tuning a tv receiver remotely is described by Adler, Desmares and Spracklen of Zenith in the March edition of ELECTRONICS. Pushbutton hammer vibrates at inaudible frequency around 40 kilocycles. Microphone in receiver operates relays that turn set on, mute sound or tune in either direction. Jangling keys don't.

THE EDITORS

Taking the Guesswork out of Plastics

PHOTO COURTESY OF INTERCHEMICAL CORPORATION

Electrical properties of resins are more and more being studied as a means of obtaining additional insight into the physical compositions of these materials. Available to today's chemicals and dielectrics manufacturer for this work are the precision measuring instruments needed . . . the G-R Capacitance Measuring Assembly and accessory Dielectric Sample Holder. This measuring apparatus permits the convenient and accurate determination of both the dielectric constant and dissipation factor of materials under investigation. The direct relationship of these electrical properties with chemical and physical characteristics of many substances provides the link that makes this Assembly the invaluable equipment it is for investigations of basic problems.

At the Interchemical Corporation, the Capacitance Measuring Assembly finds wide use both in development stages and in manufacturing for product control of the plastics coatings, films and other products manufactured by this Concern. Here, typical work performed by the G-R measuring assembly includes:

- Detection of impurities such as ionic materials, water, etc. in plastics.
- Investigation of the effects of interfacial polarization and of dipole polarization in polymers.
- The "following" of chemical reactions as they proceed in films, sheets and coatings.
- Determination of material mix needed to meet a particular electrical specification.
- Production control pertaining to a great variety of solid plastics and elastomeric substances, where electrical specifications must be closely held to meet customer requirements.
- Accurate preparation of dielectric constant vs. frequency and power factor vs. frequency curves. The instrument's wide frequency range is very helpful here.

Type 1610-A Capacitance Measuring Assembly
Complete With All Interconnection Provisions, For Two or Three-Terminal Measurements, **$2050**
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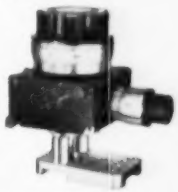
. . . makes possible direct-reading measurements of capacitance over very wide ranges: from as low as 0.1 $\mu\mu$f to 1150 $\mu\mu$f at frequencies from 30c to 100 kc; measurements to 1 μf are possible at 1 kc . . . direct reading in dissipation factor from 0.00002 to 0.56. Basic direct-reading accuracy is $\pm 0.2\%$ for capacitance and ± 0.0005 for dissipation factor; in substitution measurements, capacitance accuracy is $\pm 0.1\%$ and ± 0.00005 for dissipation factor.



Type 1690-A Dielectric Sample Holder, $435
. . . an accessory unit, readily attached to the Capacitance Bridge unknown terminals, which permits precise determinations of dielectric constant and dissipation factor of solid dielectric-materials . . . 2-inch diameter electrodes are ground to optical flatness and are micrometer driven for highest accuracy . . . this instrument is rugged, completely shielded and useful to 100 Mc and higher.

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